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The Deer IN MASSACHUSETTS

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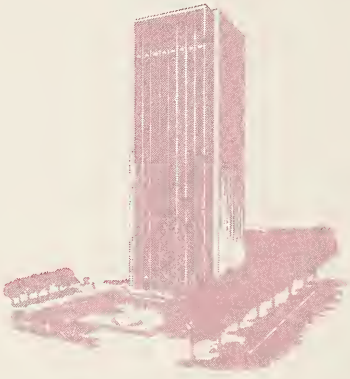

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THE MANAGEMENT OF

WHITETAILED DEER

IN MASSACHUSETTS

RESEARCH BULLETIN NUMBER 13

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FEDERAL AID, IN WILDLIFE RESTORATION — PROJECT NO. 7-R JUNE 30, 1951

PUBLICATION OF THIS DOCUMENT APPROVED BY
GEORGE J. CRONIN, STATE PURCHASING AGENT

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The authors particularly wish to acknowledge the encouragement, friendly interest, and pertinent advice of Superintendent Robert L. Jones.

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Unless otherwise stated, all photographs are official ones of the Division of Fisheries and Game, taken by Daniel Grice.

To the Board and Director
Division of Fisheries and Game
15 Ashburton Place
Boston, Mass.

Gentlemen:

Submitted herewith is a report "The Management of White-tailed Deer in Massachusetts". This is the final report of a Pittman-Robertson Federal Aid project.

Much valuable information regarding the past history, present status and future management of Massachusetts' only big game animal is found in this report.

It indicates that our deer herd is in excellent condition and warns of the importance of keeping abreast of its condition to ensure that our management for the future is wise. Many states are today evidencing serious problems with their deer populations.

Respectfully submitted,

Robert L. Jones
Superintendent

September 14, 1951

Photo by
B. R. Chaplin

PREFACE

Massachusetts deer laws have allowed the indiscriminate shooting of male and female deer of all ages year after year since 1910. In late years, an estimated 65,000 hunters invade a herd of approximately 20,000 deer and remove about one fifth of them. But in spite of the fact that hunters outnumber the deer three to one and can shoot the first deer that comes along, the trend in the deer population has moved slowly upward. This bulletin shows how this has taken place without resorting to the "buck laws" used by many other States.

The fundamental research of C. W. Severinghaus and E. L. Cheatum furnished the basic techniques that made this detailed study possible. It is gratifying to know that Massachusetts is one of the first states to make practical management use of the aging and reproductive techniques developed by these two outstanding men.

The senior author was responsible for direct leadership of the three-year study and for writing a good share of the original manuscript. The junior author carried on short-time deer studies for the State in 1946, and, in the absence of the senior author during the last few months of the study, assumed the tedious task of finishing the manuscript and putting it in final form for publication.

This bulletin serves as a final report of Pittman-Robertson Project 7-R. It is written primarily for the sportsmen of Massachusetts to provide broad factual information on a difficult wildlife management subject.

TABLE OF CONTENTS

		Page
	Acknowledgments	ii
	Letter of Submittal	iii
	Preface	v
I	Introduction	1
II	History of Deer Hunting in Massachusetts	3
	Early History	3
	Recent History 1910-1950	4
III	Environmental Influences in Massachusetts	5
	Climate	6
	Land Uses and Changes	8
	Forests	9
IV	The Sportsmen's Contribution	10
V	Some Facts About Massachusetts White-Tails	13
	Ages and Sex Ratio	13
	Weights	15
	Measurements	17
	Antlers	18
	Breeding	20
	Fawn Production	21
	Fawning Period	23
	Parasites and Diseases	23
	Food Habits	24
VI	The Fallow Deer of Martha's Vineyard	26
VII	Factors Influencing the Deer Population	27
	Significance of Age Composition	27
	Application of Sex Ratio	29
	Factors of Removal	29
	Fawn Replacement.	29
	Seasonal Changes in the Population	30
	Practical Use of the Life Equation Table	31
VIII	What Deer Management Means in Massachusetts	32
	Hunting Pressure	32
	Regional Abundance of Deer	34
	Value of Sanctuaries	34
	Effect of Deer Browsing on Forest Reproduction	35
	Limited Hunting in Closed Areas	38
	Crop Damage	39
	Indices of Over-Population	39
	Deer Management in Massachusetts Compared with Other States and Provinces	40
IX	Recommendations for Changes in Laws	41
	Changes in Present Laws	41
	New Regulations	42
X	Summary	43

I. INTRODUCTION

Why should the Massachusetts Division of Fisheries and Game bother to make an extensive study of the white-tailed deer? Is the resource really that valuable? The answer can be supplied by looking at some figures which show there can be little doubt of the white-tail's value to the people of the Commonwealth. The value of edible meat alone is substantial. The average deer kill for the past five years has been about 3325 per year. Based on nearly 1200 official weights taken in 1949, the average weight of all deer is 102 pounds hog-dressed. A deer of this weight furnishes about 76 pounds of edible meat (24).* Thus, in an average year 252,700 pounds of table venison are furnished to the citizenry.

Current meat prices are high. Based on a conservative value of 75 cents a pound, it follows that $189,525 represents the meat value alone. The deer hides, at $2.00 apiece, add another $6,650. An estimated 65,000 resident deer hunters spend a very conservative $10.00 each for ammunition, clothing, transportation costs, and other items necessary in the pursuit of deer. This adds another $650,000 to the annual value of the resource. All these values add up to roughly $850,000, which is indeed a minimum figure.

Most smart businessmen today can realize a five percent return on their investment. If $850,000 is the annual dividend or interest on Massachusetts' herd investment at this five percent, the deer herd is directly valued at about $17,000,000, or more than $5.00 for each acre of deer range in the State. Now, suppose some multi-millionaire comes along and offers a flat $17,000,000 for all the deer in the Commonwealth of Massachusetts. Do you think the sportsmen would sit back and let the State sell out the deer resource for this or any other monetary amount? The answer is obvious. It is just impossible to place a cash value on any important game species, especially deer, the presence of which furnishes such important intangible benefits to all the people.

* Number in parentheses corresponds to reference number under Bibliography.

It would not seem unreasonable, then, for the State to spend money to get some reliable information on which to base a wise management policy for this great deer resource. The only way to insure wise management of anything is to obtain facts through detailed investigation. With a wildlife species this means finding out such things as life history, habitat requirements, and factors governing removal and replacement of the population, all as a basis for formulating future regulations. Even though our deer herd is apparently holding its own without anyone knowing why, it was considered common sense not to trust to luck any longer, but to take out the guess work by going after some factual information. With a backlog of deer facts ready for use, any future trouble with the herd has a good chance of being avoided before it reaches uncontrollable proportions.

Officially titled *A Preliminary Study of the White-tailed Deer in Massachusetts,* this study began in July 1948 and continued for three years. The project set up and worked toward four broad objectives: (1) Compiling of information already available on the deer and their environment. This includes compilation and analysis of legal kill data, hunting pressure, damage payments, weather data, and the collection from other agencies of information that has a possible bearing on deer. (2) Gathering of new information on the species under Massachusetts conditions, which entails mostly the operation of deer checking stations, the study of accidentally-killed deer during the winter months, and the study of deer from areas of over-population. (3) Collecting of information on habitat preferences and population density, which deals largely with the extent of browsing, food preferences, and determination of potential deer range in the State. (4) Studying of management and control measures and suggesting recommendations for changes in present deer laws if necessary.

The sportsmen of Massachusetts are, and will continue to be, a very real part of the deer research program. With the honest intention of giving credit where credit is due, a special Chapter is titled *The Sportsman's Contribution,* wherein the number of deer voluntarily brought in to checking stations are listed by station locations and by years.

The two main purposes of the deer checking stations are to get random samples of age classes and to collect reproductive tracts from female deer. Ages show what percentage of the deer herd is being removed each year, and tracts give a good indication of whether or not fawns are being born each year in sufficient numbers to replace adequately the animals that are removed. It can be readily seen that this combination of evidence can be used to predict the trend in the deer population — whether it is rising, falling, or remaining comparatively stable. The detailed applications of this and other data collected at the stations are given throughout the bulletin. Suffice it to say here that without the sportsman's excellent cooperation the bulk of the useful information contained in this bulletin would not have been available.

It should also be mentioned here that even though the deer investigations are concluded as a full-time project, the checking station phase of the work should be continued by the State in the future. These stations should be an integral part of the State's wildlife management program because they provide a good yearly check on the status of our only big game animal.

Several other states now take advantage of this type of hunter cooperation, and all of them feel that a lot of highly useful information directly applicable to herd management is coming out of it. New York State developed the aging technique and was one of the first to use roadside checks. Other states in the northeast section which have applied it to good advan-

tage are Maine, New Hampshire, Vermont, and West Virginia. Massachusetts, with three continuous years of reliable data, stands among the leaders in this type of research. It is gratifying to report that there is reasonable assurance the stations will be continued, at least for the next few years, by State personnel working through the newly-organized wildlife management districts.

II. History of Deer Hunting In Massachusetts

The early settlers of Massachusetts found deer quite plentiful. In fact, deer were the mainstay of the colonists in Southern New England for food and for the skins, which were made into durable clothing. But by 1800 deer were quite scarce and by 1850 were practically eliminated in all sections of the State except Barnstable and Berkshire Counties, where they apparently were never completely gone. In 1898 a law was passed in Massachusetts giving deer complete protection. Aided by this law and the widespread reversion of farmland to forest, deer showed an increase in numbers, which resulted in an open season of six days in 1910 for the five western counties. In 1913 all counties were open, and there has been an open season of at least six days in some or all counties up to the present time (14).

It is interesting to fill in some of the gaps in this general summary of deer hunting. From earliest recorded history to the time of the first general open season in 1910, all information here has been condensed from an enlightening article titled *History of the Virginia Deer in New England,* by Glover M. Allen (1).

Early History

While Rhode Island, in 1646, took the lead in being the first colony to enact a closed season on deer, Connecticut and Massachusetts, which then included also the northern part of New England, were not too far behind. In 1698 it was ordered that no person should kill buck, doe, or fawn from January 15th to July 15th, and annually for a like period thereafter. Two years later (1700) the law was repealed, but in 1715 it was reenacted in nearly its original form. In 1739 the closed season was extended from January 1 to August 1 in conjunction with a law passed the same year establishing uniform protection by providing for the appointment of two persons in each town, later called *deer reeves,* whose special duty it was to see that the closed-season law was enforced. The early records of many of the older New England towns give the names of those appointed annually to this office.

The laws enacted for the protection of deer during the 1700's were no doubt feebly enforced. Deer were killed in and out of season for hides and venison, especially during winter snows, when they could be run down in the snow and killed with a knife. Dogs also were used in the chase, as well as traps and snares.

During the first three-quarters of the 1800's deer reached their lowest numbers in Massachusetts. Only in the woods and thickets of the Cape region were they definitely known to have survived in small numbers in spite of persecution, and by 1870 the Cape deer were apparently quite numerous again. The statement was made in 1877 that no less than 300 deer were killed in the Sandwich district during the two years previous.

A law passed in 1883 allowed deer to be killed anywhere in the State except on the Cape during the month of November, but since there were practically none elsewhere, this amounted to almost complete protection.

Although a few were illegally killed on the Cape every year, deer hunting practically ceased in Massachusetts for a period of years. In 1898 a new law was enacted making it illegal to kill or pursue deer before 1903. This was modified in the latter year, when an act was passed making it legal to kill deer damaging crops; and an act was passed the same year whereby the State indemnified farmers and fruit growers for crop damage by deer.

In 1902 many reports of deer from all over the State indicated their extraordinary increase under good protection. The three years preceding the general open season in 1910 were marked by sharp increases in the number of deer shot while damaging crops. Sixteen were killed by this means in 1907, 17 in 1908, and 198 in 1909. The amount paid by the State for deer damage during these same three years jumped from $2,913, to $4,370, to $7,923. The handwriting was on the wall, and something had to be done to keep the deer herd within safe numbers. A general open season was the only practical solution.

Recent History 1910-1950

Modern regulated deer seasons began in Massachusetts in 1910, when a six-day season was declared for the five western counties. From this date to the present time, one deer per hunter, regardless of size or sex, has always been the regulation. Listed in Table I is the deer kill from 1910 to 1950 inclusive.

TABLE I

DEER REPORTED KILLED BY HUNTERS IN MASSACHUSETTS

YEAR	BUCKS	DOES	TOTAL	COUNTIES OPEN	COUNTIES CLOSED	MONDAY SEASON STARTED	DAYS OF DURATION
1910	717	373	1,282	5 western	9 eastern	3rd, Nov.	6
1911	649	436	1,270	5 western	9 eastern	"	6
1912	—	—	1,231	5 western	9 eastern	"	6
1913	—	—	1,596	All		"	6
1914	—	—	1,312	All		"	6
1915	606	462	1,105	All		"	6
1916	673	378	1,051	All		"	6
1917	546	471	1,017	All		1st, Dec	6
1918	474	358	832	All		"	6
1919	474	359	833	All		"	6
1920	811	655	1,466	All		"	6
1921	577	555	1,132	All		"	6
1922	922	659	1,581	All		"	6
1923	683	489	1,172	All		"	6
1924	1,064	948	2,012	All		"	6
1925	735	605	1,340		Essex	"	6
1926	1,162	1,099	2,261		Essex	"	6
1927	1,062	907	1,969		Essex	"	6
1928	1,068	956	2,024	All	Plymouth (6 days)	"	12
1929	1,400	1,363	2,763	All		"	12
1930	856	706	1,562		10 eastern (6 days) Nantucket	"	12
1931	837	756	1,593		Nantucket	"	6
1932	559	438	997		Nantucket	"	6
1933	643	483	1,126		Nantucket-Barnstable	"	6
1934	691	533	1,224		Nantucket-Barnstable	"	6
1935	973	840	1,813	All			
1936	1,040	969	2,009		Dukes	"	6
1937	1,361	1,206	2,567		Dukes-Norfolk	"	6
1938	1,253	1,050	2,303		Dukes-Norfolk	"	6
1939	1,125	975	2,100		Dukes-Norfolk	"	6
1940	1,601	1,466	3,067		Dukes-Norfolk	"	6
1941	998	775	1,773		Dukes-Norfolk	"	6
1942	1,345	1,187	2,532		Dukes-Norfolk	"	6
1943	1,308	1,114	2,422		Dukes-Norfolk	"	6
1944	1,611	1,449	3,060		Dukes-Norfolk	"	6
1945	1,912	1,655	3,567		Dukes-Norfolk	"	6
1946	1,461	1,342	2,803		Dukes	"	6
1947	2,028	1,858	3,886		Dukes	"	6
1948	1,222	1,122	2,344		Dukes	"	6
1949	2,401	1,973	4,374	All			
1950	1,717	1,362	3,079	All			
Total	40,565	34,332	79,450				
Percent	54.2	45.8					

It is quite apparent from the kill figures in Table I that the general trend in the kill has been upward. Contrasted with the first open season, which produced 1281 deer, all but two of the seasons since 1944 have shown kills in excess of 3,000, and one of them reached an all-time record high of 4374. A better picture of the kill trend is shown in Figure 1. The two most noticeable drops in the kill are no doubt accountable to economic conditions. Shortage of hunters during the years of the first World War (1916-19) and depression years (1930-34) very likely caused the low kills for these two periods.

If the general trend in the kill continues to show an increase, and there is no apparent reason why it should not, it appears quite doubtful that future Massachusetts deer seasons will again show a kill below 3,000. Evidence will be given later to show that a kill of 4,000 or more is likely to be the rule from 1951 on.

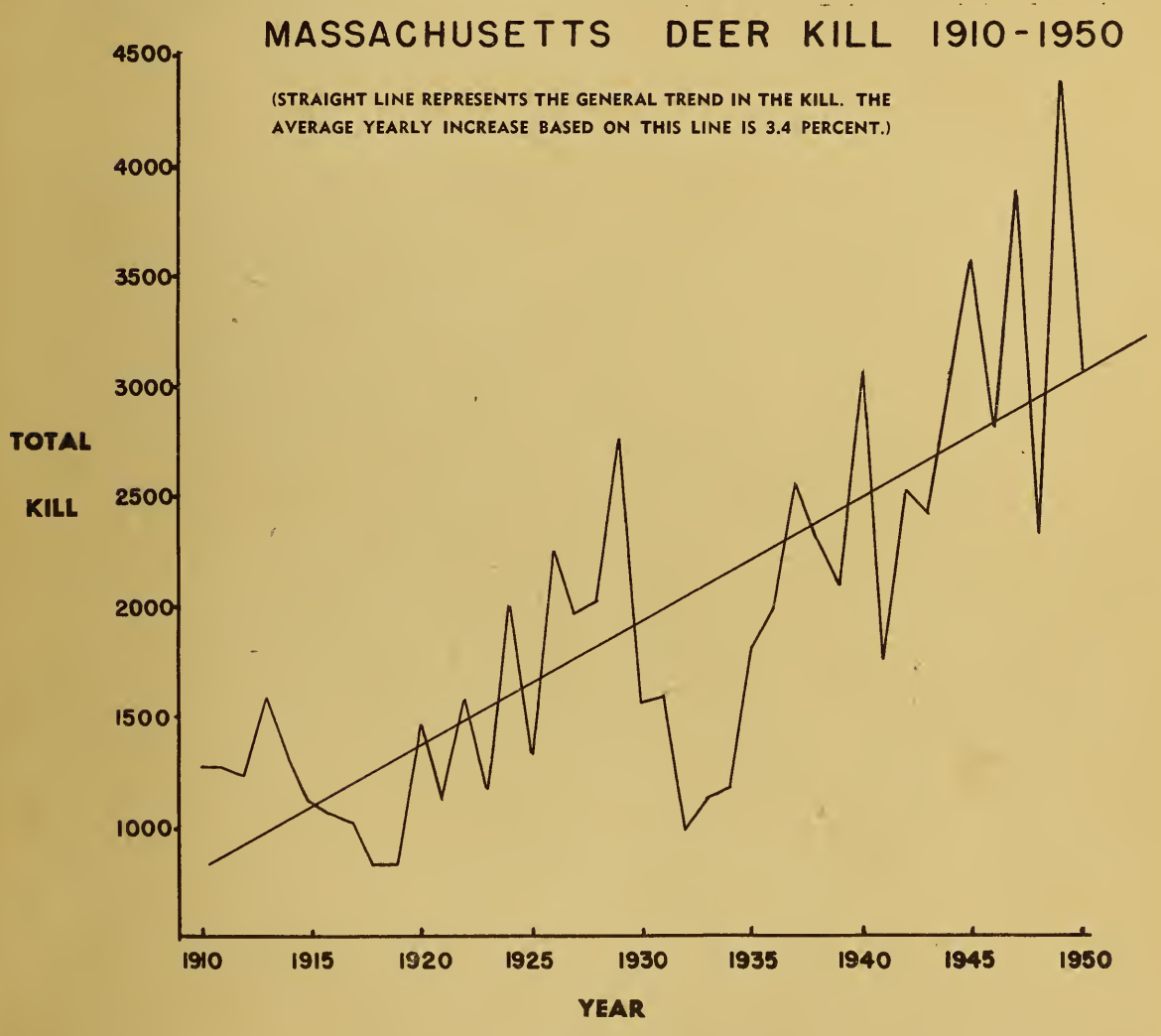


Figure 1.

III Environmental Influences in Massachusetts

It is common knowledge that all living things are influenced by the conditions under which they are forced to live. Man can move or change his surroundings to suit his needs, but deer have to stay rather close to where they are born and accept things as they are. It is in order, then, to take inventory of the several influences which force their effect on the deer population and give some evaluation to the various factors which directly or indirectly relate to the welfare of the herd.

Climate

Primary consideration is usually given to climate. Although it varies considerably from the mild conditions of Cape Cod, called by some the "Miami of Massachusetts", to the more rigorous conditions of the western Berkshire Hills, in general the climate is humid, with annual temperatures about 47 degrees Fahrenheit. Winter temperatures average 26 with several days going below zero, and summer temperatures average 69 with a few reaching over 100. These figures apply generally to the central section (21) and probably represent the average conditions prevailing in most of the State except Barnstable County and the Islands. The growing season, as a rule, extends from May into early October, a period of about five months. During this time the deer's diet can be supplemented with fresh green leaves, nutritious herbs, and occasionally and unfortunately some tender apple shoots or fresh garden vegetables, all of which are much richer in essential nutrients than woody browse found in the forest (10). It is during this warmer weather that deer store up considerable quantities of excess fat to tide them over the leaner winter months.

Winter mortality among deer is caused largely by deep snow. Studies in New York (22) have shown that when deer are forced to contend with snow depths of 20 inches or more for extended periods they weaken rapidly. During such periods the deer expand more energy in traveling, and the availability of food is sharply curtailed, but these deep snows must last at least five weeks to significantly affect deer mortality. At ten weeks the effect becomes severe. When mortality from excessive snows is prevalent, the younger animals are the first to succumb. Michigan studies (4) have shown that over 90 percent of the starved deer are fawns from the previous spring and that in some yards 50 percent or more of the previous year's fawn crop may be killed off.

Fortunately, Massachusetts deer are relatively free from any wholesale winter mortality for two reasons. First, deer are not too numerous even during winter concentrations brought on by deep snows, because Massachusetts laws, which always have permitted the shooting of both bucks and does, keep the population well in balance with the range. Secondly, snow conditions which cause these concentrations occur quite infrequently. This last statement is substantiated by weather records of the U. S. Weather Bureau in Boston, which were made available for special study. A compilation of the average number of consecutive days when snow depths exceed 15 inches shows that the winters of 1944-45 and 1947-48 have been the only severe ones since 1938. The 1944-45 winter was the less severe of the two, and it appears quite unlikely that any substantial mortality resulted, because it was estimated that the yarding period did not exceed four weeks.

Snow conditions during the 1947-48 winter, however, could have been severe enough to cause some noticeable mortality. All 14 weather stations in the State with complete snow-depth data showed an average of 45 consecutive days when snow accumulations were sufficient to cause the deer to be restricted in movement and available food. Weather stations at Montague and Concord reported more than 70 days of such conditions. It was concluded that during this winter deer yarding averaged at least six weeks, and in certain localized areas probably reached nine weeks. But, as stated above, these losses are not common and when they do occur, are far less severe than in most States because of Massachusetts' well balanced deer population.

Soils

In recent years more and more attention has been focused on the relationship of soils to wildlife. The interactions between the two are still imperfectly understood, but in general it is becoming increasingly apparent that the quantity and quality of most game species are somehow related directly to certain minerals in the soil associated with native fertility. A probable case in point is the difference in reproductive capacities of the does in two separate regions of New York State (18). It was found that female deer from the Adirondacks showed both a lower percentage of pregnancy and a lower rate of fawn production than females from the Southern part of the State. This difference was explained partly by pointing out that the soils of the Central Adirondacks are largely granitic in origin and probably lower in essential mineral components than the richer and more heterogenous soil mixtures found elsewhere.

Additional work in the field of nutrition suggests that animals have the ability to select minerals to supplement specific dietary deficiencies (20), and deer have been known to single out and browse heavily on forest plots experimentally fertilized with sodium nitrate and ammonium sulfate.

Do regional differences in Masachusetts soils reflect the quantity and quality of deer found on them? Quite likely they do, but to date not enough evidence has been accumulated to make any statement on the subject, mostly because it is not known which essential minerals are associated with healthy plant and thus healthy animal growth.

Most Massachusetts soils have only low to moderate native fertility. Beaumont (5) writes as follows concerning the general condition of Massachusetts soils: "Climate has exercised a tremendous influence on the character of Massachusetts soils. A continental glacier pushing southward thousands of years ago rejuvenated and redistributed the pre-existent soil mantle, and softened a previously harsh landscape. In the period of 25,000 or more years which have elapsed since the last invasion of an ice sheet, generous precipitation, aided by a cool climate and coniferous forest cover, has caused Massachusetts topsoils to be leached of soluble bases, thereby producing the northern gray or grayish soils referred to . . . as podzols."

Beaumont continues: "Siliceous rocks, particularly granites, gneisses, schists, and quartzites predominate in the parent material of Massachusetts soils, and largely account for their sandy texture and, in part, for their acid reaction. West of the Connecticut Valley, and particularly in the Berkshire Valley, limestone formations have influenced and improved the quality of the soils. Sandstones and shales have impressed their characteristics on the soils of the Connecticut Valley and the Narragansett Basin."

Even though the native fertility of most Massachusetts soils is comparatively low, it is generally conceded that they respond quickly to good management for agricultural purposes. This response, plus soil conservation, make possible a high level of fertility. It would seem possible, although speculative, that some of the soils made fertile by farms of 60 years ago, now abandoned and serving as deer range, remain today in a more fertile condition than soils which were always under forest cover. As will be seen shortly, farm abandonment played an important role in the history of Bay State deer.

Land Uses and Changes

Land utilization in Massachusetts, based on land use surveys of 1936-38 and U. S. Census figures of 1940, can be grouped into the following major categories (21):

Non-Farm Land	*Percent*	
Woodland	50.1	
Densely Settled	6.0	
Water	3.1	
Swamps and Waste	2.8	
		62.0
All Farm Land		
Improved	15.4	
Woodland	14.2	
Other	8.4	
		38.0

What do these land-use percentages mean in terms of present deer range? All the woodland (64.3%) can be considered deer range. Swamps, some wasteland, and other small classifications add roughly another 2½ percent. In general, about ⅔ of the entire State, including islands, can be considered potential deer range. The following breakdown presents the picture a little differently and in terms of acres (2):

All Forests	3,260,000
Agriculture	1,221,080
Developed (Cities, Roads)	543,000
Barren (Sand, Rocks)	36,400
Inland Water	139,000
Gross Area	5,199,480

To the 3,260,000 acres of forest can be added approximately another 110,000 acres of deer range from the agriculture and barren area classifications to place the total deer range for the State, including islands, at 3,370,000 acres, or 5,265 square miles. The general distribution and types of this range can be seen by refering to Figure 2. For a detailed breakdown of the amount of deer range in each township and county, see the listing in the Appendix titled *Massachusetts Deer Kill by Townships and Counties, 1939 - 1950.*

The trend of land utilization in Massachusetts makes an interesting story. Anyone who would like to go into detail on this subject should read *Interrelationship of Land Uses in Rural Massachusetts* by David Rozman (21). From the standpoint of deer range, the first factor that comes to attention is the general trend in the amount of land which has reverted from farm use to forests. In 1880, when agricultural land utilization was still high, about ⅔ of the total area of the State was devoted to farming, as compared with the present farming area of only 38 percent. This means that more

than 1,400,000 acres of land, representing almost 26 percent of the total area of the Commonwealth, went out of agricultural use and into deer range.

The reasons for the decline of improved farm land relate in varying degrees to changing types and systems of farming, soil erosion and deterioration, non-resident land ownership, disappearance of town industries, and the growth of residential, recreational, commercial, and other more intensive uses of the land. The present non-resident ownership of about ⅔ of all land in rural towns has contributed largely to the increasing amount of land under wooded cover.

Farm abandonment accidentally provided more favorable conditions for deer, as well as most other forms of wildlife. Low-growing game foods and cover are much more plentiful and more varied, both in species and distribution, in abandoned farm areas than they were in the virgin forest. Old fields with groups of shrubs and apple trees furnish fruit and browse and contain many valuable herbaceous species beneficial to deer and wildlife in general.

Forests

What kinds of forests do we have in Massachusetts? In general, they are the kinds commonly considered good deer habitat. There are no vast stretches of mature trees associated with real wilderness, because past and present lumbering operations have broken up the age composition of most stands. As of 1926, it was estimated that 43.7 percent of all trees were two inches or less in diameter, 36.8 percent were between two and six inches, 15 percent between six and ten inches, and only 4.5 percent ten inches or more.* These figures show that cutting must have been going on almost continuously.

From the standpoint of available deer food, the more cuttings the better, provided adequate trees are left for cover and shelter. Young hardwood sprouts following cuttings are ideal as food for browsing game, such as deer and rabbits. Some game species, such as cottontails and woodcock, which were absent or scarce in the dense old-growth forests have come in as a result of the clearing and abandonment of farm land.

Continuous cuttings are going on mainly because the forests contain several trees which have some commercial use. White pine, hemlock, red spruce, red oaks, white oaks, hard maple, red maple, white birch, ashes and hickories all have a high commercial value; these all grow in certain sections of Massachusetts. The oaks and maples grow universally throughout the State. Other species of moderate commercial use found in the State are red pine, pitch pine, balsam fir, white cedar, beech, poplar, and basswood. The following species are native to Massachusetts, but their use for commercial purposes is rather restricted: black spruce, red cedar, silver, maple, yellow, black and gray birch, butternut, elms, sycamore, red and black cherry, sassafras, tupelo, yellow poplar and black locust. There are many more kinds of trees native to the State, but the ones listed above are most likely to be cut for commercial reasons. In 1938 there were about 350 sawmills in the State, all of which were in operation at some time during the year (2).

* Figures based on study by Mass. Div. of Forestry, summarized by H. O. Cook in 1926.

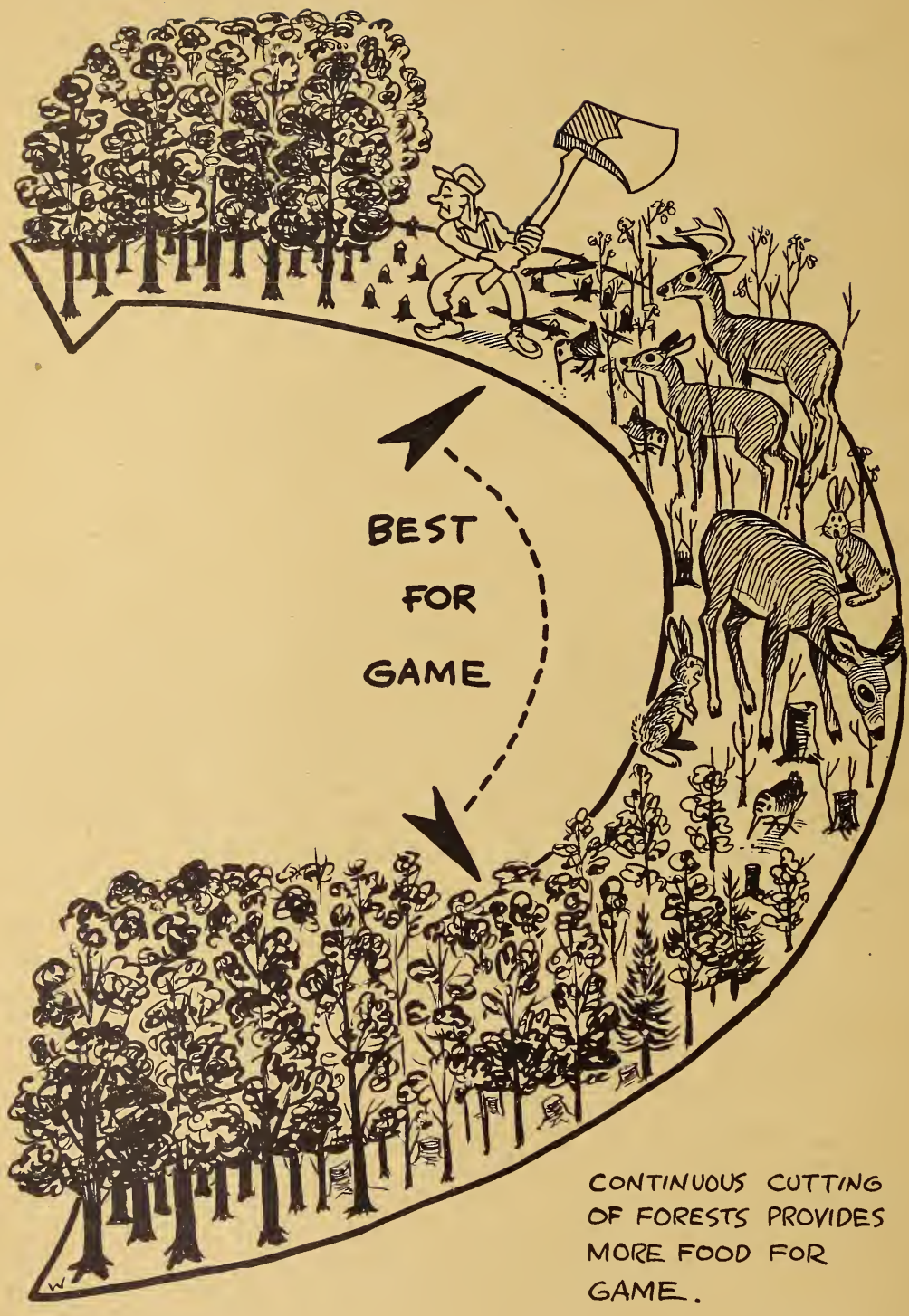


Figure 2 shows the major natural forest regions of Massachusetts. The map was compiled from forest survey data collected by the Massachusetts Division of Forestry between the years 1916 and 1932. A comparison of this map with the one showing distribution of deer as revealed by hunter-kill reports (center-spread map) does not reveal any consistent relationship between forest regions and regional abundance of deer.

MAJOR NATURAL FOREST REGIONS OF MASSACHUSETTS

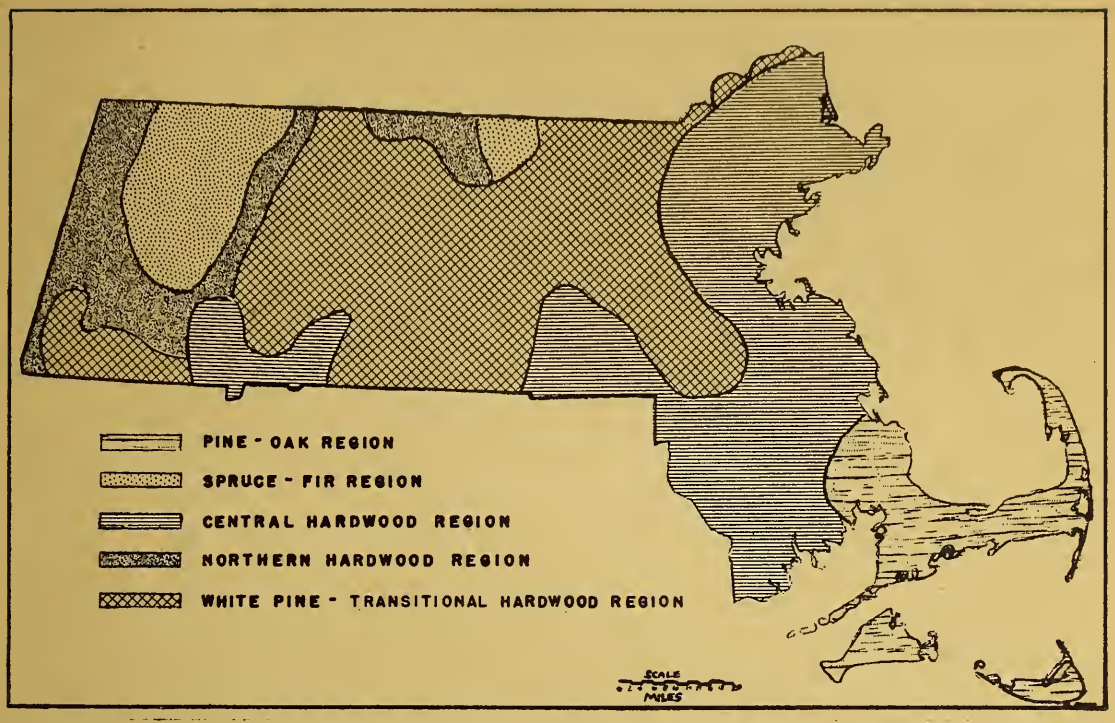


FIGURE 2.

IV. THE SPORTSMEN'S CONTRIBUTION

Two thousand three hundred and ninety-three — that is the number of sportsmen in Massachusetts who are thanked and congratulated for the co-operation they furnished by stopping in with their deer at one of the State's deer checking stations during the years 1948, 1949, and 1950. Each one can feel that he made a material contribution to the deer research program and to the future management of the State's deer herd. The employees of the Division of Fisheries and Game, through its Bureau of Wildlife Research and Management, are looking forward to a continuation of this fine co-operation.

As a matter of record and guidance for the future, each checking station for the three year period is listed in Table II along with the number of deer checked at each station. Also indicated for each year are the total in the sample and the percent of that sample in relation to the total kill.

TABLE II

NUMBER OF DEER CHECKED BY STATIONS IN MASSACHUSETTS DURING THE OPEN SEASONS OF 1948, 1949, 1950

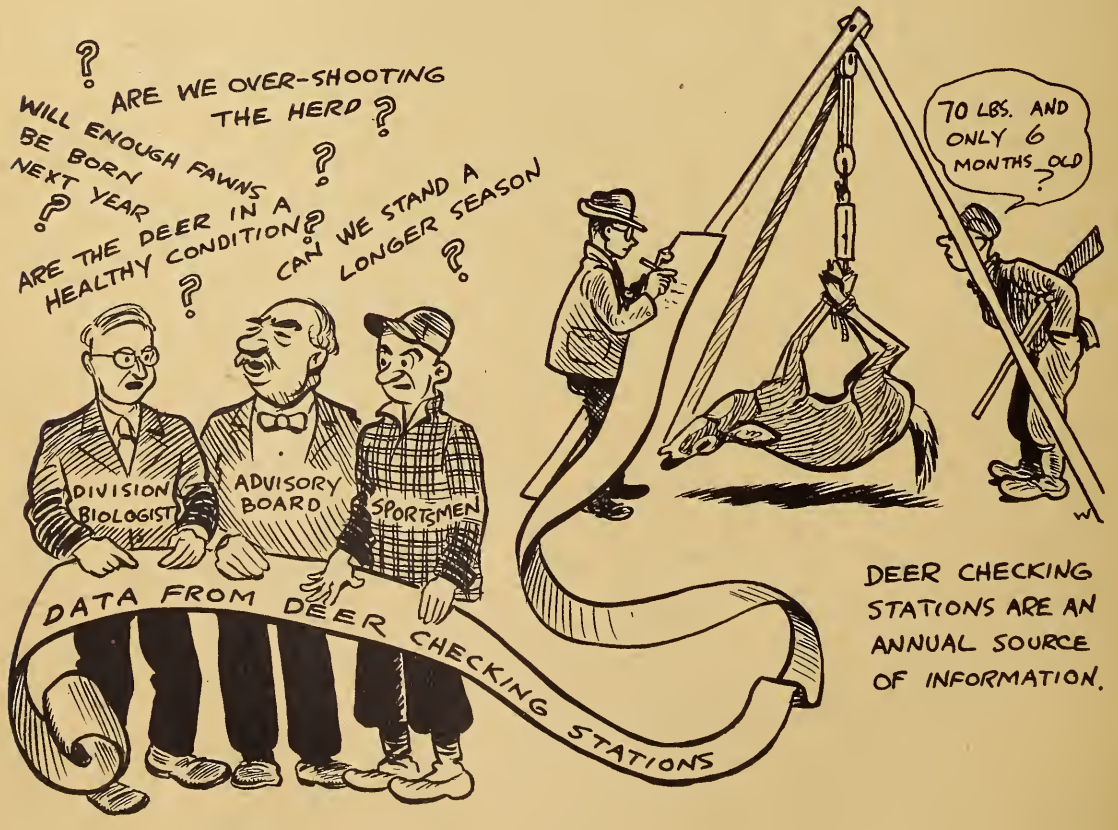
1948		1949		1950	
STATION	NUMBER CHECKED	STATION	NUMBER CHECKED	STATION	NUMBER CHECKED
Barre	95	Barre	175	Assonet	10
Becket	42	Belchertown	112	Athol	56
Belchertown	8	Bourne	28	Barre	165
Brewster	25	Fitchburg	66	Belchertown	100
Florida	56	Ipswich	17	Brewster	33
Littleton	18	Lee	81	Fitchburg	29
Middleboro	24	Martha's Vineyard	29	Gt. Barrington	47
So. Deerfield	42	Middleboro	31	Martha's Vineyard	18
Misc.	9	Nantucket	63	Mobile Unit	13
		No. Adams	89	Nantucket	30
		Pittsfield	121	No. Adams	84
		Plymouth	21	Pittsfield	79
		Shelburne Falls	90	So. Deerfield	69
		Shrewsbury	20	Sturbridge	25
		So. Deerfield	104	Westfield	115
		Sturbridge	42		
		Westfield	111		
Total	319	Total	1,200	Total	873
Reported Kill	2,344	Reported Kill	4,374	Reported Kill	3,079
Percent Sample	13.6	Percent Sample	27.4	Percent Sample	28.3

The sportsmen of Massachusetts should be proud of the fact that their cooperation has resulted in one of the largest samples of deer checked in any of the states carrying on this type of research. Only West Virginia, with a 31.1 percent sample in 1949, is known to have done any better. The cooperation of Massachusetts sportsmen has indeed been appreciated.

After three years of experimenting with different locations for setting up the checking stations, it is recommended that stations located in the following towns be kept permanently, if possible. The selection is based not only on the desirability of securing a large sample but also the necessity of sampling deer from all major sections of the State. The only station in the following list not yet tried out and found satisfactory is the one at Woods Hole. This new location is recommended because it is figured that deer will be coming off boats from all Islands in Dukes County. The previous station at Martha's Vineyard sampled deer from only that one Island. Here is the list, 15 in all:

Athol
Barre
Belchertown
Brewster
Fitchburg
Gt. Barrington
Ipswich
Middleboro
Nantucket
No. Adams
Pittsfield
So. Deerfield
Sturbridge
Westfield
Woods Hole

It is urged that the sportsmen of the State keep this list in mind for the purpose of local publicity in the future. Thanks again, sportsmen, for the fine spirit of cooperation. Carry on the good work in the future.


ARE WE OVER-SHOOTING THE HERD?
WILL ENOUGH FAWNS BE BORN NEXT YEAR?
ARE THE DEER IN A HEALTHY CONDITION?
CAN WE STAND A LONGER SEASON?
70 LBS. AND ONLY 6 MONTHS OLD?
DIVISION BIOLOGIST
ADVISORY BOARD
SPORTSMEN
DATA FROM DEER CHECKING STATIONS
DEER CHECKING STATIONS ARE AN ANNUAL SOURCE OF INFORMATION.

V. Some Facts About Massachusetts White-Tails

Many of the more popular questions asked by hunters about the white-tailed deer will be answered in this chapter. Such good questions as: How old do Massachusetts deer get? Are there more bucks or does? At what age are deer fully grown? How much does the average full-grown buck weigh? Can you tell the age of a deer by its antlers? When do they breed? When is the fawning period? What foods do they like best? All these questions and more too are answered here and supported by factual information.

Ages and Sex Ratio

Those hunters who stopped at the checking stations realize that ages of deer are determined by an examination of replacement and wear of teeth on the lower jaw. The State now has 15 complete "jaw boards" on which are placed lower jaws of deer in each age class from the fawn group through to the 10½-year class. The best way to grasp the aging technique is to study this board and note the various changes that take place from one age group to the next. But since a general understanding of age determination can be realized through pictures, a few representative samples are shown in Figure 3. Credit for the development of this aging method goes to C. W. Severinghaus and John E. Tanck (23) of the New York State Conservation Department.

The detailed discussion of ages will be given complete coverage at the beginning of the following chapter, because use of the data will be made there to discuss factors of removal. Suffice it to say here that about 35 to 40 percent, probably about 38 percent, of the entire deer population just before the hunting season is composed of animals born the same year. Each succeeding age class is reduced by about 38 percent, which means that 1½-year-old deer make up about 24 percent, 2½-year-old deer 15 percent, 3½-year-old deer 9 percent, and so forth. Expressed another way; a hunter has less than a 50/50 chance of bagging a deer over 1½-years old. He has one chance in 18 of getting a deer over 5½, and one chance in 500 of bringing home an animal over 10 years old. That gives some idea of the life expectancy of wild deer under Massachusetts hunting conditions.

One of the oldest deer on record in the northeastern states was a 16½-year-old doe which died of old age in Warren County, New York. The animal was picked up as a fawn and allowed to roam the woods during the year, except for a period of about two months during the hunting season when she was confined and fed hay, grain and ground feed. "On a warm sunny afternoon in mid-September she died of old age . . . while she was asleep". (26) The enamel on the teeth of her lower jaw was so worn away there was almost nothing left to chew on. It is usually considered doubtful that few if any deer existing completely in the wild live beyond 15 years of age (31).

The ratio of bucks to does has been established from two sources, and both give the same result. Any hunter can tell a buck from a doe by the presence of antlers on older deer and by the presence or absence of external genitals on fawns. Hunters have been required to report the sex of their deer ever since the first open season. Between 1910 and 1950, 40,565 males and 34,332 females were reported taken. This gives a sex ratio of approximately 54 males to 46 females. Since any deer, buck or doe, has always

FIGURE 3.

Fawn. Three premolars and one molar show above gum line. Third premolar with three cusps. Note whether incisor is milk tooth (small) or adult tooth (large). Third molar will never show in fawn class.

1 yr. - 7 mos. Original premolars now replaced with permanent (usually white) teeth. Posterior cusp of third molar still barely visible. No noticeable wear on any teeth.

Photos by New York Conservation Dept.

6 yrs. - 6 mos. All premolars show definite signs of wear for first time. They appear similar to heavily-worn temporary premolars of deer 1 yr. and 5 months old. Chewing surface of two sections of first molar bridged together by dentine.

HERE ARE YOUR TARGETS. OUT OF EVERY 100 THE AGE GROUPS WILL BE ROUGHLY LIKE THIS.
FAWNS 38
YEARLINGS 24
2½ YEARS 15
3½ YEARS 9
4½ YEARS 6
5½ to 10½ YEARS 8

been legal game during the same hunting period in Massachusetts, it can be assumed that hunters remove the deer at the same ratio as they exist on the range. Embryos taken from accidentally-killed does during the winters of 1948-49 and 1949-50 supplied a further check on this ratio. Of 74 embryos collected from this source, 40 were males and 34 females: also a ratio of 54/46 in favor of the bucks. Even though this is a small sample, it does suggest a predominance of male deer.

Weights

To speak of the average weight of a deer does not mean much unless that weight is related to the deer's age and sex. Naturally a six-month's old buck would not weigh as much as a 3½-year-old buck, nor would any doe, as a rule, be as heavy as a buck even in the same age class. Weights of Massachusetts deer can be clarified by studying Table III.

TABLE III

AVERAGE WEIGHTS OF MASSACHUSETTS DEER BY SEX AND AGE BASED ON 1873 SAMPLES COLLECTED DURING THE OPEN SEASONS OF 1948, 1949, AND 1950

(Hog Dressed Weights in Pounds)

AGE	WEIGHT		NO. IN SAMPLE	
(YEARS)	MALES	FEMALES	MALES	FEMALES
½	66	60	237	246
1½	104	95	329	171
2½	126	103	234	192
3½	152	112	148	104
4½	161	112	62	32
5½	165	112	39	24
6½-10½	165	112	30	25

Table III, besides fulfilling its primary purpose of showing average weights by sex and age, also indicates when bucks and does stop putting on

weight. It can be seen that bucks add little weight after 5½ years, whereas the does seem to reach their maximum weight at 3½ years. The size of the sample in each case would seem to be adequate to reflect true weight relationships.

It must be borne in mind that the weights given in the Table are hog dressed weights, determined after the removal of internal organs including heart, liver, and lungs. Several hunters ask what their deer would weigh before anything is removed, the so-called live weight. Figure 4 will supply the answer. This graph is based on the live weight-dressed weight relationship of 100 deer killed accidentally in Massachusetts during the months of November through April, 1949 and 1950.

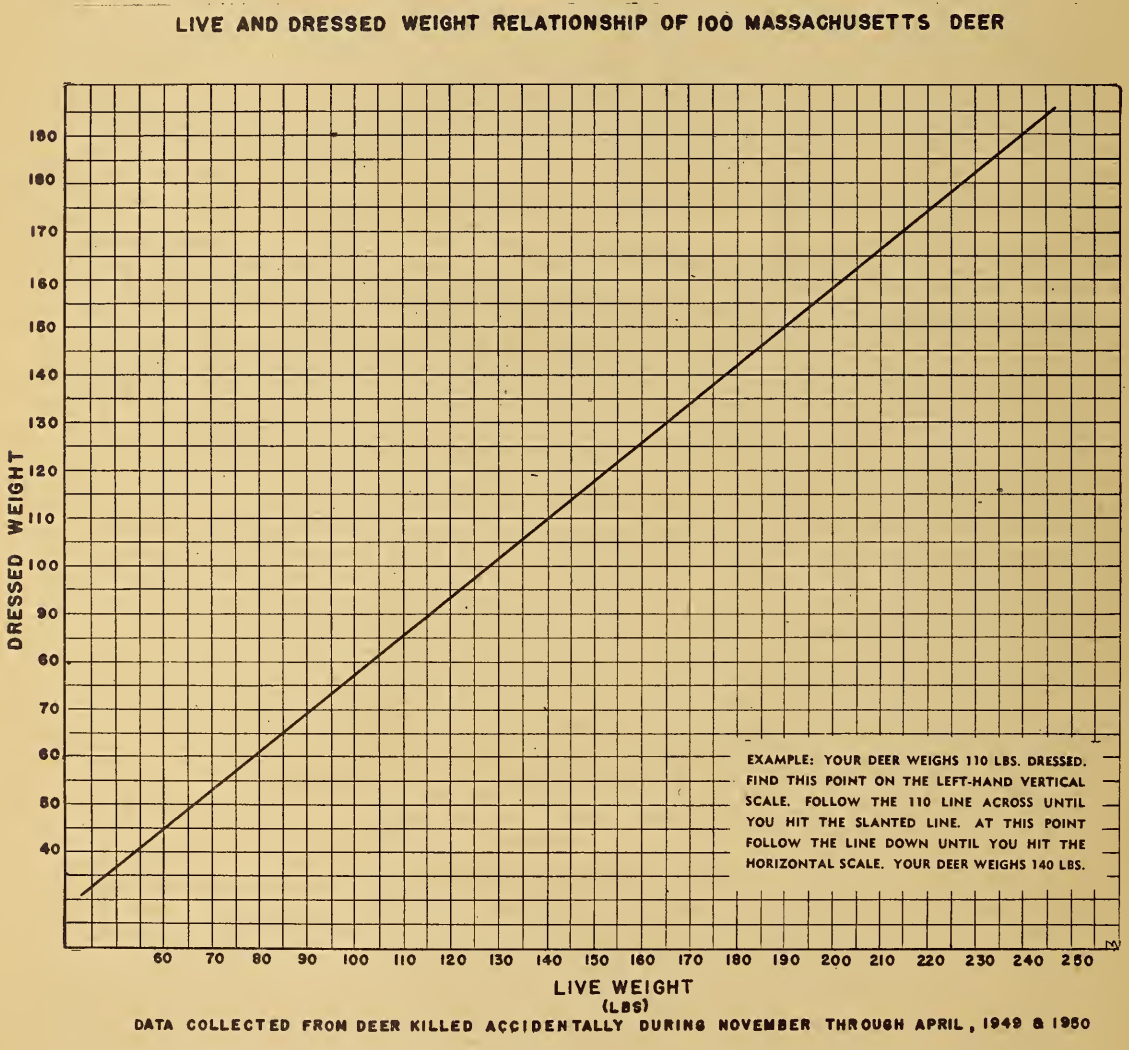

LIVE AND DRESSED WEIGHT RELATIONSHIP OF 100 MASSACHUSETTS DEER
DRESSED WEIGHT
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250
LIVE WEIGHT
(LBS)
EXAMPLE: YOUR DEER WEIGHS 110 LBS. DRESSED. FIND THIS POINT ON THE LEFT-HAND VERTICAL SCALE. FOLLOW THE 110 LINE ACROSS UNTIL YOU HIT THE SLANTED LINE. AT THIS POINT FOLLOW THE LINE DOWN UNTIL YOU HIT THE HORIZONTAL SCALE. YOUR DEER WEIGHS 140 LBS.
DATA COLLECTED FROM DEER KILLED ACCIDENTALLY DURING NOVEMBER THROUGH APRIL, 1949 & 1950

FIGURE 4.

There have been a few loud cries from well-meaning sportsmen in the State, particularly on the Cape, that Massachusetts deer are becoming stunted as a result of inbreeding. Their solution to the problem would be to import some "big deer from Maine" to improve the breeding stock and assure bigger and heavier deer for Massachusetts. This brings up the question: Is there any real difference between the weights of Massachusetts and Maine deer? In answer to this inquiry, the Maine Division of Inland Fisheries and Game furnished some unpublished reports (8) (19) giving official weights by age classes of 150 deer weighed in during the 1948 season and 222 for the 1949 season. Although the Maine deer are repre-

sented by a smaller number of weight samples, the available data indicates the following: (a) The weights of fawns from the two States are about the same. (b) Massachusetts' yearling deer average about 10 pounds heavier than the Maine yearlings. (c) Full-grown Massachusetts bucks average about 15 pounds lighter than the fully-matured Maine bucks. (d) Full-grown Massachusetts does average about 15 pounds heavier than fully-mature Maine does. These are not meant to be conclusive statements of facts, but the evidence at hand certainly does not suggest that Bay State deer are stunted. In fact, their weights would indicate the deer to be in excellent condition. All body measurements taken pointed toward the same conclusion. The deer are of good size.

FIGURE 5.

A large eight point buck killed by a car. Massachusetts deer are comparable in size with those found in other New England States.

Measurements

Three measurements are recorded for each deer made available at the checking station: (1) the length of the hind foot from the hock bone to the end of the longest toenail, (2) the height of the shoulder from the top of the shoulder blade to the end of the longest toenail, and (3) the total length of the body from the base of the tail to the tip of the nose. All measurements followed the contours of the animal as they would have appeared in a natural standing position. Table IV gives a summary of the three years' results.

TABLE IV

AVERAGE MEASUREMENTS OF MASSACHUSETTS DEER BY SEX AND AGE BASED ON SAMPLES COLLECTED DURING THE OPEN SEASONS OF 1948, 1949 AND 1950

(Measurements in Inches)

Age	Measurements						Number in Sample					
	Hind Foot		Shoulder		Body		Hind Foot		Shoulder		Body	
(Years)	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
½	17.1	16.5	33	31	48	47	281	268	236	219	243	138
1½	19.1	18.3	38	36	56	54	392	205	300	162	335	174
2½	19.7	18.6	40	37	60	56	269	211	223	182	240	195
3½	20.0	18.8	41	38	63	58	173	114	138	89	159	102
4½-10½	20.0	18.8	42	38	65	58	142	95	123	74	133	74

Table IV shows that females reach their maximum skeletal size at 3½ years, since all three measurements are the same for the 3½-year class as well as the 4½ to 10½-group. Although the hind foot length of the males remains the same after 3½ years, there is some evidence from the Table that shoulder and body growth continue for another year. Data not included in the Table because of insufficient samples indicate that the body length of males is 64 inches at 4½ years and 65 inches from 5½ years on. This would mean that maximum skeletal growth of the bucks is reached at 5½ years and for the does, as just mentioned, at 3½ years. It will be recalled that maximum weights of bucks and does are reached at these same ages. The two indices should go hand in hand, as they do.

Antlers

Normally, only male deer have antlers, but quite infrequently a freak female will grow a small set. Such a case was recorded at the Pittsfield checking station during the 1950 season. David R. Miner, in charge, reported examining a deer that appeared to be a normal female in every respect except for the presence of two prominent spikes about two inches long. Captive female deer have been induced to grow antlers by being given male hormone called testosterone (33), but why occasional antlers appear on females in the wild is still a mystery.

Antlers are shed each winter, usually from late December through January and February. New antlers start to grow from two to six weeks later, attaining full size by late summer. Growing antlers are covered with a delicate vascular membrane called *velvet,* which wears away or is rubbed off once growth ceases. Shedding of the velvet takes place in late summer, after which mature antlers are no longer sensitive or easily injured (31). Wislocki's work (32) has shown that antler development and growth are directly associated with the functioning of the testes. He writes: "Castration of Virginia deer in the first eight months of life results in complete suppression of antler growth. Castration after the appearance of the first set of antlers, if the antlers are in velvet, results in the permanent retention of the velvet and failure of the antlers to be shed. Castration in the presence of antlers which have lost their velvet results in immediate shedding of the antlers and their subsequent renewal and permanent retention in the following year."

Further, he writes: "The annual onset of antler growth takes place at a time of minimal testicular function, shedding of the velvet upon increasing testicular activity, and antler shedding at a period of declining function of the testes." It is significant to note in this connection that the only bucks

having shed antlers during the open season in Massachusetts (first full week in December) were either yearlings or deer aged as 10½ years older. Apparently the young and the very old bucks have a shorter rutting span than the others.

Contrary to the still-lingering notion among some sportsmen, antler development and age are not closely related. Table V shows that about half the yearling bucks are spike horns and half have more than two points, about ⅓ of the 2½-year old bucks have eight points, and ⅔ have more or less than eight points, 3½-year old bucks may have anywhere between three and twelve points. In view of these observations, it can be stated conclusively that age and the number of points on the rack of a deer have no consistent relationship.

The reader may find Table V rather difficult to interpret. The number of points includes those present on both antlers. That is, if the buck had four points on one antler and five on the other, it was called a nine-point rack. The actual figures are percentages. Take the 3½-year group as an example. None of them was a spike horn (two points), less than 1 out of 100 had three points, about 7 out of 100 (6.7) had four points, about 3 out of 100 (2.8) had five points, about 42 out of 100 had eight points.

TABLE V

Antler Point Distribution of Massachusetts Bucks by Ages Based on 967 Samples Collected during the Open Seasons of 1948, 1949, and 1950

(Expressed in Percentages)

Age (years)	No. in Sample	2	3	4	5	6	7	8	9	10	11	12
1½	382	49.2	9.9	18.1	9.7	7.8	1.6	3.4	—	0.3	—	—
2½	260	6.5	3.5	11.2	9.6	16.9	12.3	33.5	3.8	1.9	0.4	0.4
3½	179	—	0.6	6.7	2.8	10.6	8.9	41.9	9.5	13.4	3.4	2.2
4½	77	—	—	—	2.6	3.9	3.9	41.6	20.7	14.3	6.5	6.5
5½-10½	69	—	—	—	—	1.5	11.6	36.2	18.8	18.8	11.6	1.5

There are certain generalizations that can be made from the data in Table V: (a) If a spike horn is killed in Massachusetts there is about a 50/50 chance it is a yearling deer, and no chance at all it is 3½-year old or older. (b) Deer of all ages are more likely to have an even number of points than an odd number. (c) The greatest majority of bucks over the yearling class have eight points. (d) Deer of the older age classes (5½ to 10½) have the greater number of points.

Another aspect of antler development, and one more closely (although by no means definitely) associated with age, is the diameter of the two main beams. Beam diameters one inch above the base of the antlers were recorded by age classes on 893 bucks, and the results are given in Table VI.

TABLE VI

Average Antler Beam Diameters of Massachusetts Bucks by Ages Based on 893 Samples Collected during the Open Seasons of 1948, 1949 and 1950

Age (years)	Number in Sample	Measurement in Millimeters	Measurement in Inches
1½	339	17.6	0.7
2½	245	24.7	1.0
3½	161	30.3	1.2
4½	76	33.4	1.3
5½-10½	72	36.2	1.4

The annual increase in the antler beam diameter from one age class to the next might be construed as indicating a method of assigning deer of known antler beam diameters to age classes. But this is not advisable, because there is considerable overlapping between the higher measurements of any one class and the lower measurements of the age class just above it. For example, the beam diameters of yearlings in 1949 ranged from 10 mm. to 26 mm., of 2½-year olds from 14 mm. to 37 mm., of 3½-year olds from 20 mm. to 44 mm. Even though average beam diameters involving several deer show a consistent increase by ages, no individual deer could be assigned a difinite age class solely from a beam diameter measurement.

Severinghaus (23) has shown that antler beam diameters can be used as a kind of condition factor with which game managers may be able to evaluate range adequacy in relation to the number of deer. He found in New York that there were regional differences in beam measurements according to the quality of the range. A comparison of Massachusetts and New York data on this count reveals that the quality of deer range in Massachusetts taken as a whole compares favorably with the best or next best range in New York State. In other words, it seems that the quality of deer food in Massachusetts is adequate. Antlers, then, furnish further evidence that Bay State deer are in good physical shape.

Breeding

There are two aspects to the subject of breeding: When do deer breed? How many young do they have? The answer to the first question has been summarized in Table VII. Breeding dates given in the Table are based on the normal growth of embryos taken from accidentally-killed does. The crown to rump measurement of an embryo indicates how many days that embryo has been growing (6). The breeding date, then, equals the date the mother was killed minus the age of the embryos in days. In this way, breeding dates for 47 adult does and 10 fawns were determined.

TABLE VII

BREEDING DATES OF 57 MASSACHUSETTS DOES AS DETERMINED FROM EMBRYO DATA

ADULTS (YEARLINGS AND OLDER)

Date of Breeding	Number of Occurrences
October 31	1
November 1	3
" 7	1
" 10	2
" 11	1
" 12	3
" 13	1
" 14	1
" 15	4
" 16	3
" 17	3
" 18	3
" 19	3
" 20	2
" 21	3
" 22	2
" 23	2
" 24	1
" 25	2
" 30	1
December 3	2
" 4	1
" 6	1
" 15	1
Total	47

FAWNS (7 TO 9 MONTHS OLD)

Date of Breeding	Number of Occurrences
November 22	1
" 29	1
" 30	1
December 3	1
" 4	1
" 8	2
" 10	1
January 20	1
" 29	1
Total	10

SUMMARY BY MONTHS
(Both Age Groups Combined)

	Number	Percent
Bred During October	1	2
" " November	44	77
" " December	10	17
" " January	2	4

It can be readily deduced from Table VII that the bulk of breeding among adult does occurs between November 10 and November 25. Actually, 36 out of the 47 adult females, or 77 percent, bred between these two dates. Whereas about 90 percent of the adults bred before December 1, and none after December 15, the majority of the fawns (70%) mated in December and January. Quite similar breeding spans were noted in New York, where the peak of the breeding season for adults practically coincided. Embryo measurements recorded on 37 pregnant fawns in that State showed that 70 percent of fawn breeding occured during December, and the latest date was February 18 (18). This delay in the onset of heat exhibited by fawns is very likely due to late maturity of the genital organs.

Cheatum's studies (7) point out that one heat period lasts about 24 to 36 hours. If a doe is not bred during this time, she comes into heat again approximately 28 days later. In cases of persistent breeding failure, as many as three heat cycles may occur. However, Table VII indicates that most all Massachusetts does are bred during their first heat period in November, which would imply no scarcity of breeding bucks. A few of the December-bred adult does in Massachusetts may have been serviced during their second period of heat, although this late breeding could be attributed to delay in the onset of the first heat. Such speculation is not important. The significant fact is the vast majority of them do become pregnant, and they produce a very sizeable fawn crop.

The rutting season of males apparently coincides with the breeding season of females, otherwise the latter would not be conceived. Wislocki (32) recorded the weights of testes from 13 adult bucks collected during the four seasons on Naushon Island, Massachusetts. The heaviest testes were taken in October and the lightest from the late winter to early summer. His examinations revealed the presence of sperm beginning in July, with the maximum in October, and a diminishing number in December and January. None was found in March, May or June. New York data (6) agree except for the presence of some sperm in one adult buck collected March 5 and none in another collected July 15. This combination of evidence suggests spermatogenic activity over a period of eight months, but does not imply the ability of the bucks to service successfully over the entire period. Early and late records of pregnancy, however, show that some bucks are capable of breeding for at least five months, hence their fertility would seem to overlap by considerable margin the breeding season of the does.

Male deer will service more than one mate, and in circumstances where the females greatly outnumber the males, it is probable that one buck will serve as many as 10 does or more (31). By actual trial in Pennsylvania, 17 does have been mated successfully to a single male during a breeding season of normal length, with no apparent ill effects upon the male or the size, number, and vigor of the offspring (9).

Fawn Production

Attention can now be turned to the second aspect of the breeding story: How many young do the females have? To understand the answer, it is necessary to define the terms *corpora lutea* and *corpora lutea-embryo relationship,* and to discuss their use for predicting fawn production. Since Cheatum (7) has described these terms and their application in considerable detail, only brief reference to the subject is given here, mainly to clarify the interpretation of data given in Table VIII.

Corpora lutea literally mean *yellow bodies,* and they refer in this case to the solid yellow bodies found in one or both ovaries of a female deer. The presence of the bodies usually means the female has bred successfully and, 92 times out of 100, will produce one young for each corpus luteum. The ratio of 92 to 100 is the corpora lutea-embryo relationship which was established from the study of accidentally-killed females sent to the Upton Laboratory. Most reproductive tracts collected during the open season do not contain visible embryos, but since the accidentally-killed females were killed mostly between January and April, they furnished information on both the number of corpora lutea and the number of embryos per doe. Then the relationship can be applied to the samples from which only corpora lutea counts are available. Over a two year period it was learned that 100 corpora lutea actually represent 92 fawns. In other words, if 50 adult does shown an aggregate of 100 corpora lutea (average of two per doe), those same 50 females actually would produce 92 fawns. This is why it is necessary to take 92 percent of the average corpora lutea count in order to determine the true fawn rate per pregnant doe. Then this rate must be reduced a certain percent to allow for those which are not pregnant.

The bulk of the information on corpora lutea counts came from genital tracts furnished by hunters who stopped at the checking stations. But since most fawns are not pregnant during this time, tracts from fawns had to be supplied mostly through accidentally-killed fawns furnished by Conservation Officers. Since relatively few fawns were killed in this way, the sample in the fawn class is small.

As with previous information presented, the rate of reproduction depends on the age of the animal. Fawns, yearlings and adults are therefore treated separately in Table VIII. The reader still may find Table VIII difficult to interpret. Follow through the adult class as an example. The average corpora lutea count per pregnant adult doe is 2.04. Since only 92 percent of the corpora lutea represent growing embryos, take 92 percent of 2.04 to get the average embryo count per pregnant doe. This gives 1.88. But only 85 out of 86 (98.8%) of the adults sampled were pregnant. If 1.88 represents the average embryo count of pregnant does, 98.8 percent of it, or 1.86 represents the average embryo count or future fawn production of all adult does in the population. Following the same reasoning, all the yearlings will produce an average of 1.53 fawns, and all so-called fawns, actually about 12 month old at fawning time, will bear an average of 0.58 offspring.

TABLE VIII

Average Fawn Production of Massachusetts Does by Age Groups Based on 153 Samples Collected during the 1948, 1949 and 1950 Breeding Seasons

	Fawns (17 Samples)	Yearlings (50 Samples)	Adults (86 Samples)
Average corpora lutea count per pregnant female	1.06	1.80	2.04
Average embryo count per pregnant female (92 percent of corpora lutea count)	0.98	1.66	1.88
Percent of females pregnant	58.8	92.0	98.8
Average fawn production per female in total population	0.58	1.53	1.86

Since Table VIII gives no indication of the percentages of different-aged females which bear singletons, twins, and triplets, these will be given here. All pregnant fawns, with one exception, produced a singleton. The one exception was a fawn which bore twins. Among the pregnant yearlings,

28 percent produced singletons, 63 percent twins, and 9 percent triplets. Among the adults, the following percentages prevailed: 14 percent singletons, 68 percent twins, 18 percent triplets.

Fawning Period

The period of pregnancy for white-tailed deer is between 190 and 200 days. The average is about 196 days (6) or roughly 6½ months. The fawning season can be determined easily by adding 196 days to the breeding dates given in Table VIII. Based on the 57 samples at hand, it was figured that the earliest fawning occurs about May 14 and the latest around August 13. This embraces a three-month period. It will be recalled that 77 percent of all breeding among yearlings and adults occured between November 10th and 25th. The peak period for fawning then falls between May 24 and June 8. By months, the samples show that fawns are born as follows: 40 percent during May, 56 percent during June, none during July, and 4 percent during August. These few August-born fawns no doubt account for the three or four "collie-dog-size" deer weighed in each year at less than 45 pounds.

FIGURE 6.

Deer with warty growths called *fibromas*. These growths are not common on Massachusetts deer and do not affect the edibility of the flesh.

Parasites and Diseases

Massachusetts deer seem to be remarkably free from any harmful parasites or diseases. In the Cape Cod region quite a few deer were infested

with common wood ticks (*Dermacentor variabilis*). They were found in the ears and nasal cavity, but their occurrence on all animals in the region is a natural thing and causes no apparent detrimental effects.

Perhaps a half dozen deer during the three year period of the study were reported as having warty growths distributed over the body. One of these (Figure 6) was brought to the Upton Laboratory for examination. On this specimen there were 30 to 40 sessile tumor masses, some small, some large. A scab-like coating covered most of them.

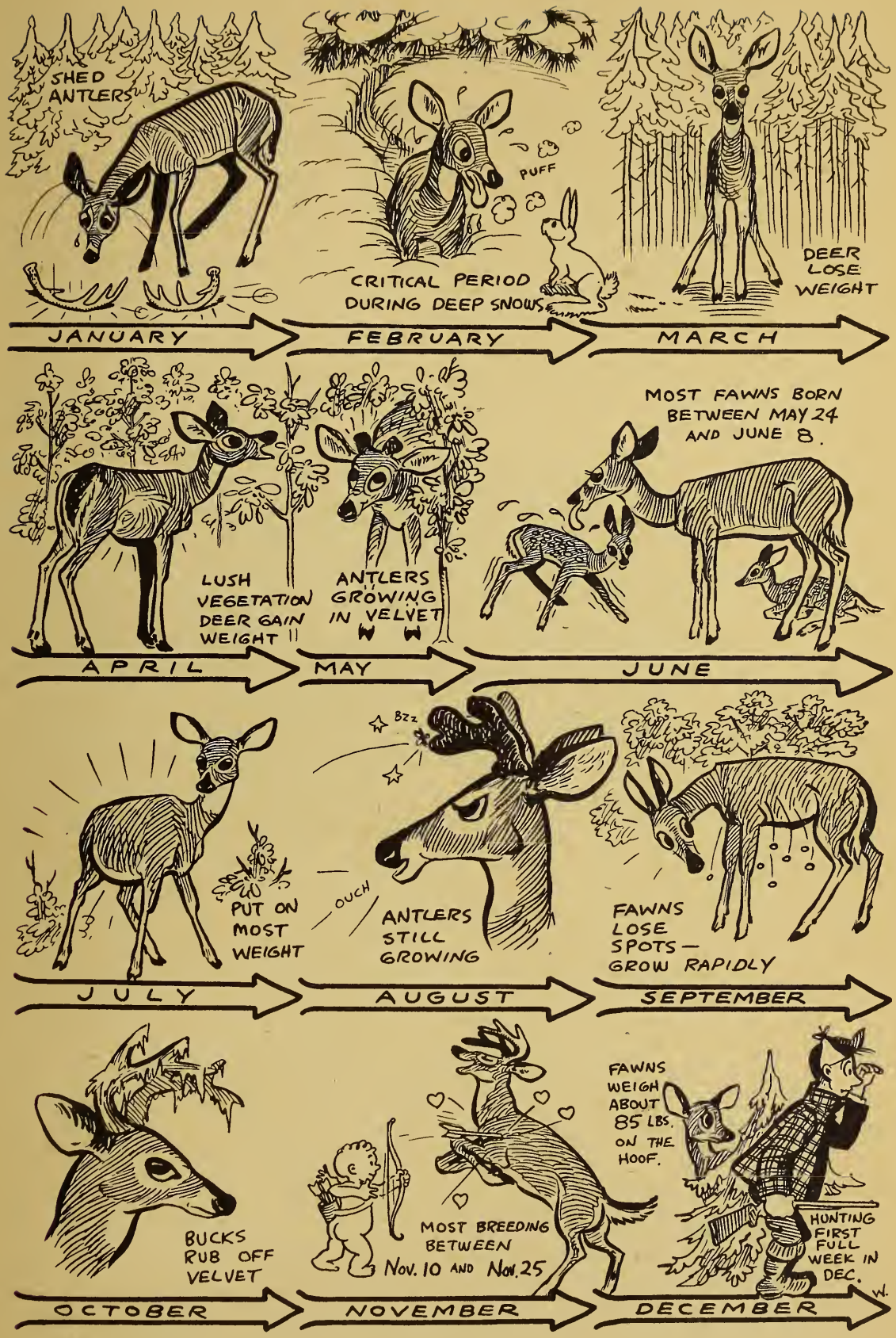
The warty growths are called *fibromas* of the skin. Correspondence with Dr. George B. Wislocki (34) of the Harvard Medical School revealed that the fibromas are not known to be transferrable to other deer, to cattle, or to man. They continue to grow and, by becoming ulcerated, might perhaps cause the death of the deer. This question was asked: "Will the skin tumors in any way harm the meat so that it would be advisable not to eat it?" Wislocki replied: "The tumors in themselves should not cause the meat to be inedible. Were any of the lesions found to be badly infected or ulcerated, one would perhaps be hesitant to regard the meat as edible."

Food Habits

The seasonal food habits of white-tailed deer are summed up nicely by Trippensee (31) whose comments apply directly to Massachusetts conditions. He writes: "The deer is a ruminant. As with all ruminants, its diet is chiefly vegetable materials, consisting of browse, a wide assortment of herbaceous food-stuffs, and certain kinds of fruit when available. The first two categories supply by far the bulk of the food consumed, with browse being the principal staple in winter, augmented by herbaceous materials at other seasons. By browse is meant the leaves, buds, twigs, and bark of woody plants. In regions having extensive oak forests and where heavy accumulations of snow do not prevent, acorns supplement the fall and winter diet in years of large seed crops. Mast is eaten most freely in the autumn; if deep snow covers the crop during the winter, it again becomes available the following spring. Oak and beech are the two main mast-producing trees.

"At other seasons during the period of vegetative growth, the diet contains a high percentage of vegetable foods of all kinds; the leaves of woody plants, grasses, and other herbaceous materials in abundance. Browsing on bark and woody twigs continues throughout the year, but to a lesser degree during the growing season, since the leafy product of the current season's growth asumes a priority position in the food diet. Feeding during the summer months is a combination of browsing and grazing; the latter commences in the spring with the first appearance of lush new grasses and other herbs and continues into the autumn as long as their palatability is retained."

A browse survey conducted in 1950, showed that among the woody plants deer showed a preference for the maples, ashes, viburnums, and dogwoods. Others commonly utilized were hemlock, oaks, black and yellow birch, hazelnut, blueberry, aspen and cherry.


SHED ANTLERS
JANUARY
PUFF
CRITICAL PERIOD DURING DEEP SNOWS
FEBRUARY
DEER LOSE WEIGHT
MARCH
LUSH VEGETATION DEER GAIN WEIGHT
APRIL
ANTLERS GROWING IN VELVET
MAY
MOST FAWNS BORN BETWEEN MAY 24 AND JUNE 8.
JUNE
PUT ON MOST WEIGHT
JULY
Bzz
OUCH
ANTLERS STILL GROWING
AUGUST
FAWNS LOSE SPOTS— GROW RAPIDLY
SEPTEMBER
BUCKS RUB OFF VELVET
OCTOBER
MOST BREEDING BETWEEN Nov. 10 AND Nov. 25
NOVEMBER
FAWNS WEIGH ABOUT 85 LBS. ON THE HOOF.
HUNTING FIRST FULL WEEK IN DEC.
W.
DECEMBER

VI The Fallow Deer of Martha's Vineyard

Of all the game animals pursued by hunters in Masachusetts the fallow deer is by far the least known. This deer, a native of southern Europe and Asia Minor, was first released on Martha's Vineyard in 1932 and has since established itself on the Island.

The fallow deer differs quite markedly from the native white-tailed deer. It is a stout, sturdy, but graceful animal, having more or less conspicuous spots throughout its life. It is smaller than the native deer, measurements taken at the checking station showing it to be 4 to 8 inches smaller in length and height.

Mature fallow bucks carry very impressive antlers which are flattened resembling those of the moose (see figure 7). A buck three and a half years or older checked during the 1949 open season had antlers measuring over 7 inches wide with 25 points and a spread of 35 inches from tip to tip. Another specimen, a yearling, carried foot long spikes, but these antlers, unlike those of yearling white-tailed bucks, were knobby at the tips and knurled at the base.

Figure 7

Head of a fallow deer shot on Martha's Vineyard. Note that the antlers sweep toward the rear and are flattened much like those of a moose.

Reports are contradictory as to the place of procurement of these deer and the exact number brought in, but is is generally agreed that the original stocking consisted of 3 to 5 animals obtained from a park in Worcester, Mass. According to a report from a Vineyard sportsman, another liberation was made in 1938, when an additional 8 fallow does were released.

The fallow deer apparently found the habitat of the Island favorable, because by 1949, when the deer season was opened on the Island, there were an estimated 150 of them. During this one week's open season an estimated 15 fallow deer were taken along with 35 white-tails. Approximately the same number were killed during the open season in 1950.

The ability of this animal to maintain its numbers under hunting is not known nor is the effect it may have on the native white-tail. Certainly this knowledge should be obtained before any thought is given to releasing

them anywhere else in the State. The Division will watch with interest the progress of this newcomer to the game animals of the State.

VII. Factors Influencing the Deer Population

From the standpoint of showing how research applies to management, this chapter can be considered the most important part of the bulletin. Given here is the basis for answering such practical questions as: Can we stand a longer deer season? Did the record kill of 4374 in 1949 mean that fewer deer would be available for the 1950 season? What is the deer population in Massachusetts? In order to get at the roots of these questions, it is necessary to tie together practically all the vital statistics collected during the study. The age composition, sex ratio, factors which remove deer from the population, and fawn replacement are the basic considerations. Each must be treated separately, at first, in order to grasp the combined effects of them all. If the reader will follow the discussion step by step, he will readily understand the life equation table, which gives the status of the population in condensed form.

Significance of Age Composition

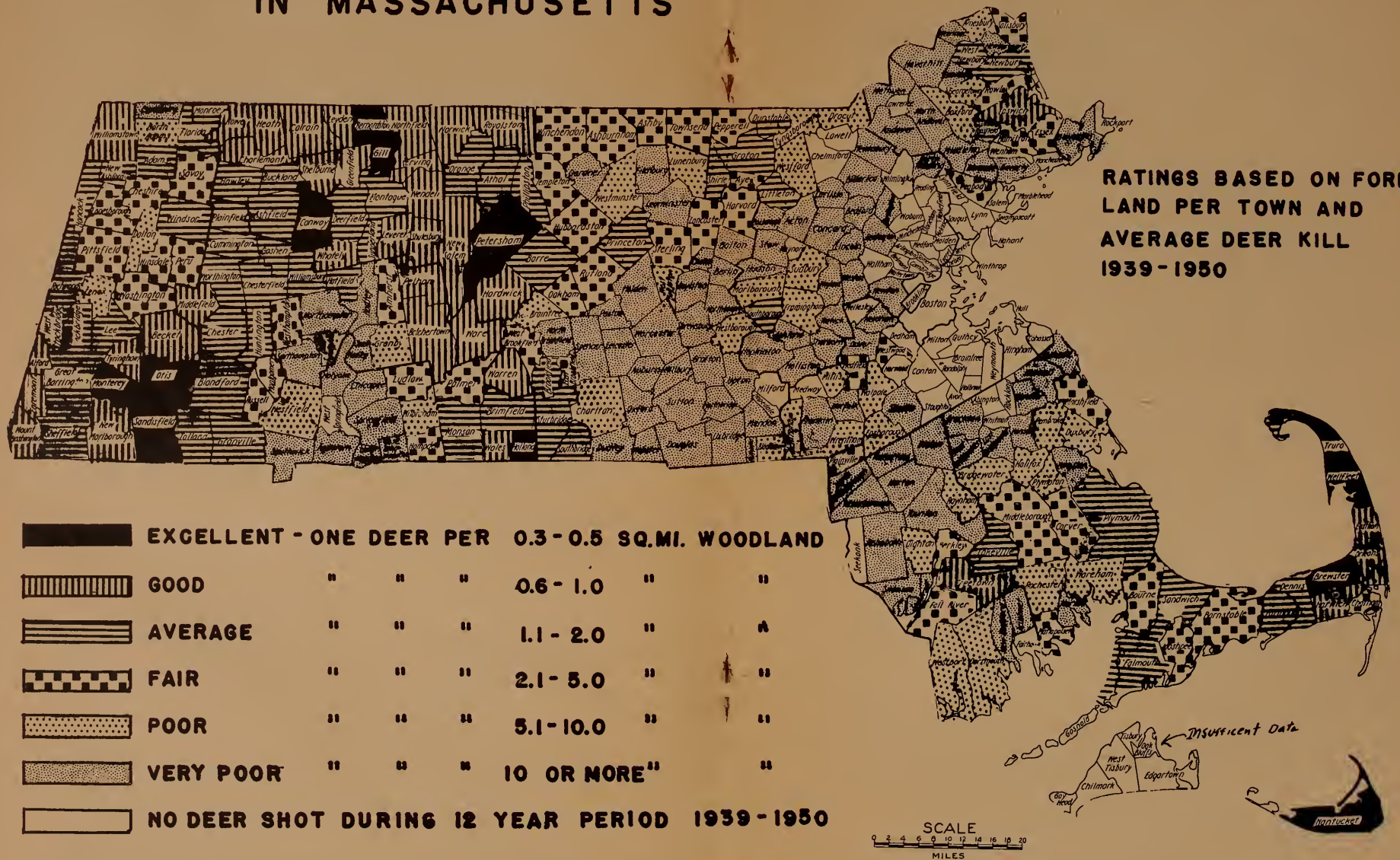
The ages of deer recorded at the checking stations represent a random sample of ages of all the deer shot. Since hunters shoot indiscriminately all deer regardless of size or sex, the age samples also represent a cross section of the age composition of the entire deer herd. The principal value of getting this breakdown of ages is to determine the *average annual removal* of deer from the total population *from all causes* — hunting as well as the four other main factors, which include illegal kill, accidentally killed by dogs, and killed while damaging crops.

How does the age composition show this total average annual removal? To understand the answer to this, the number of deer in each age class must be stated and analyzed. Over the past two hunting seasons (1949-50) good random age samples were taken of 1385 deer. These do not include fawns, because it became apparent that hunters were reluctant to bring the smaller animals to the checking stations. The breakdown by ages of these 1385 deer is as follows:

Age (years)	Number Checked
1½	535
2½	387
3½	247
4½	102
5½	55
6½	26
7½	17
8½ - 9½	10
10½ & over	6

It can be readily seen that there is a noticeable drop-off in the number of deer from one age group to the next oldest group. There is a 28 percent drop from the 1½ to the 2½, a 36 percent drop from 2½ to 3½, a 59 percent drop from 3½ to 4½, a 46 percent drop from 4½ to 5½, and so on. It was determined statistically that the average decline between all successive age classes was about 38 percent. Now, this means that over the past several years, an average of approximately *38 percent of the deer population has been removed from all causes.* Figure 8 presents the information graphically. The solid blocks on the graph represent the actual number of deer

DEER HUNTING AREAS IN MASSACHUSETTS


RATINGS BASED ON FOREST LAND PER TOWN AND AVERAGE DEER KILL 1939-1950
EXCELLENT - ONE DEER PER 0.3 - 0.5 SQ.MI. WOODLAND
GOOD " " " 0.6 - 1.0 " "
AVERAGE " " " 1.1 - 2.0 " "
FAIR " " " 2.1 - 5.0 " "
POOR " " " 5.1 - 10.0 " "
VERY POOR " " " 10 OR MORE " "
NO DEER SHOT DURING 12 YEAR PERIOD 1939 - 1950
Insufficient Data
SCALE
0 2 4 6 8 10 12 14 16 18 20
MILES

checked in each age class, and the broken line, for comparison, represents a theoretical decline of 38 percent. The age classes 1½ through 7½ years were chosen to illustrate the principle.

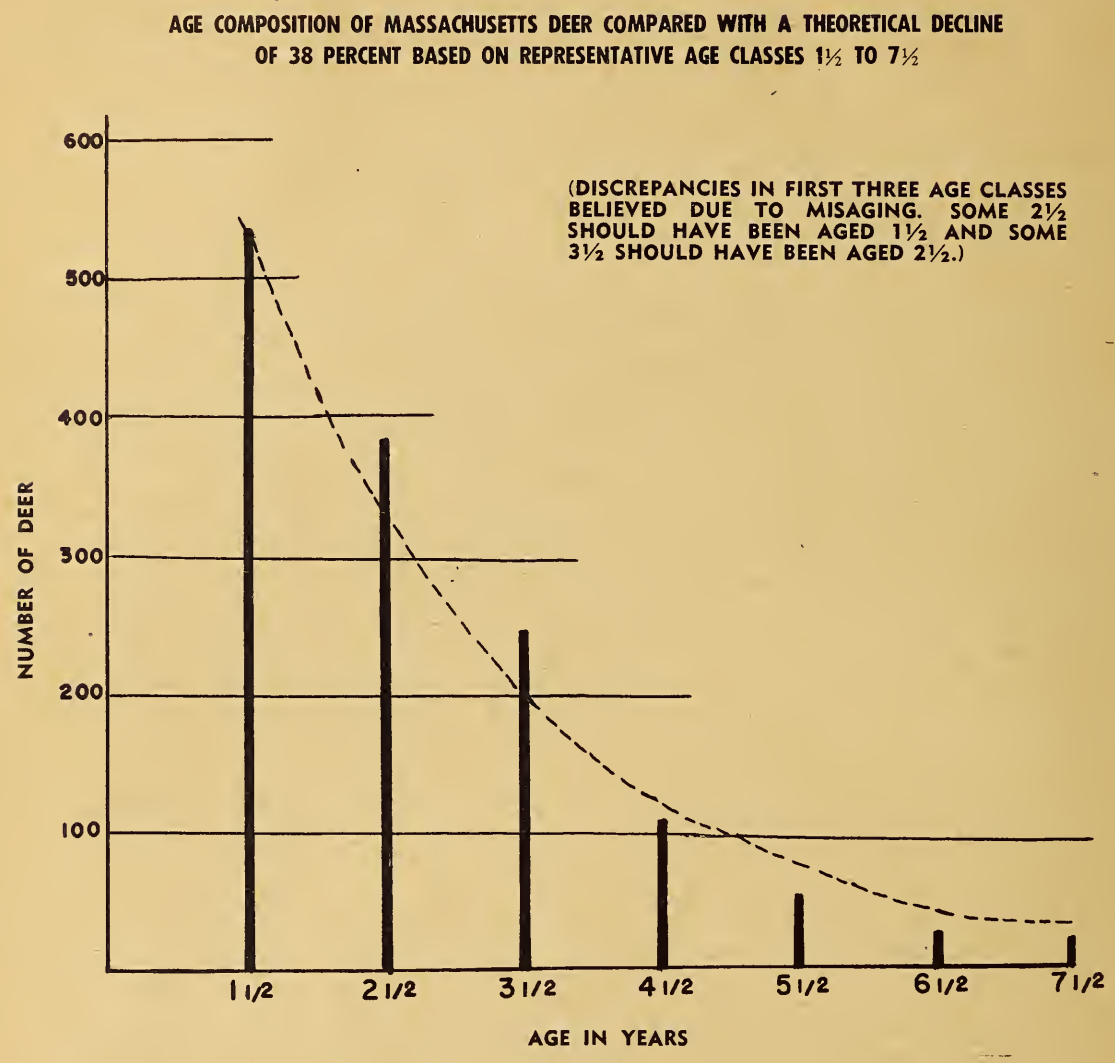

AGE COMPOSITION OF MASSACHUSETTS DEER COMPARED WITH A THEORETICAL DECLINE OF 38 PERCENT BASED ON REPRESENTATIVE AGE CLASSES 1½ TO 7½
(DISCREPANCIES IN FIRST THREE AGE CLASSES BELIEVED DUE TO MISAGING. SOME 2½ SHOULD HAVE BEEN AGED 1½ AND SOME 3½ SHOULD HAVE BEEN AGED 2½.)
NUMBER OF DEER
600
500
400
300
200
100
1 1/2
2 1/2
3 1/2
4 1/2
5 1/2
6 1/2
7 1/2
AGE IN YEARS

FIGURE 8.

Now it is possible to set up a theoretical deer population based on an average annual uniform removal of 38 percent and a population of 1000 deer. One thousand is chosen because it is easier to convert the figures to percentages and thus grasp the full significance of the removal and replacement factors discussed later.

Such a population would show this breakdown:

AGE (YEARS)	NUMBER OF DEER
½	380
1½	236
2½	147
3½	91
4½	57
5½	35
6½	22
7½	14
8½	8
9½	5
10½	3
Over 10½	2

Application of Sex Ratio

The sex ratio of Masachusetts deer (Table II) is approximately 54 percent bucks to 46 percent does. In terms of the total population, still based on 1000 deer, the following number of males and females would exist in each of the two major age groups. Yearling deer and all older age classes are now grouped as adults for the purpose of simplifying subsequent discussions:

Fawns:	205 males,	175 females,	380 total
Adults:	335 males,	285 females,	620 total

Factors of Removal

The basic working population is now composed of 380 fawns and 620 adults for a total of 1000 deer. This is the pre-hunting season population shown at the start of Table IX. It has already been determined that during the course of a year (one pre-hunting season to the next), 38 percent of the population is removed by all causes. It is now in order to analyze the influence of the various factors which make up this removal. The one positive bit of information is the legally reported kill, but it is also known that a certain percentage of the total kill is not reported, and some deer die each year as the results of wounds inflicted during the open season. Best available information, based on reported kill in relation to the total estimated population, indicates that about 25 percent of the entire population is removed each year as a result of the one week open season. Estimates by Conservation Officers show the breakdown in this 25 percent to be as follows:

Legally reported kill	20 percent of total population
Estimated Kill not reported	3 percent of total population
Crippling Loss	2 percent of total population
Total	25 percent of total population

Since the total removal is 38 percent; and 25 percent is taken as a result of the open season, a 13 percent loss is attributable to all other causes. Records of Conservation Officers, plus an estimate by them of cases not reaching their attention, give reasonably accurate figures on how many deer are removed each year from the four principal out-of-season causes. These, when related to the entire population, show the following influences in percentages:

Illegal kill by man	8 percent of total population
Accidental kill	3 percent of total population
Killed by dogs	1 percent of total population
Killed damaging crops	1 percent of total population
Total	13 percent of total population

This 13 percent, plus the 25 percent removed as a result of the open season, combine to make up the 38 percent removal determined from the age composition. Attention can now be turned to the subject of fawn replacement in the population.

Fawn Replacement

Are enough fawns born each year to replace those animals removed from all the causes just mentioned? The breeding rates tell the story, and these have already been established previously. All that need be done now is

relate these breeding rates to the number of females in order to find out how many fawns are added to the population.

As can be seen in Table IX, it is figured that 29 percent of all deer are removed between the pre-hunting season and the pre-fawning season (25% – open season, 4% – other causes). Twenty nine percent of 1000 deer is 290 deer. If these 290 deer are removed, 710 are left at the pre-fawning season. The Table shows that out of the 710 deer 125 are female fawns and 203 are female adults. The reproductive rates based on these numbers can now be applied to females. A weighted average for yearlings and adults combined has been used:

125 female fawns with a reproductive rate of 0.58 equals 73 new fawns
203 female adults with a reproductive rate of 1.72 equals 349 new fawns

Seventy three plus 349 places the new fawn crop at 422. Related to the original 1000 deer, this represents a 42.2 percent increase. During the course of a year, from one pre-hunting season to the next, it appears that 38 percent of the deer are removed and about 42 percent replaced, which shows roughly a four percent increase. The various seasonal changes which result in this four percent increase can be studied by referring to Table IX.

Seasonal Changes in the Population

The best way to show seasonal changes in the population and to appreciate their significance is to present this so-called life equation. The basis for understanding the equation has been established, but for quick reference it should be restated that the population is based on an average annual removal of 38 percent and a sex ratio of 54 percent bucks and 46 percent does.

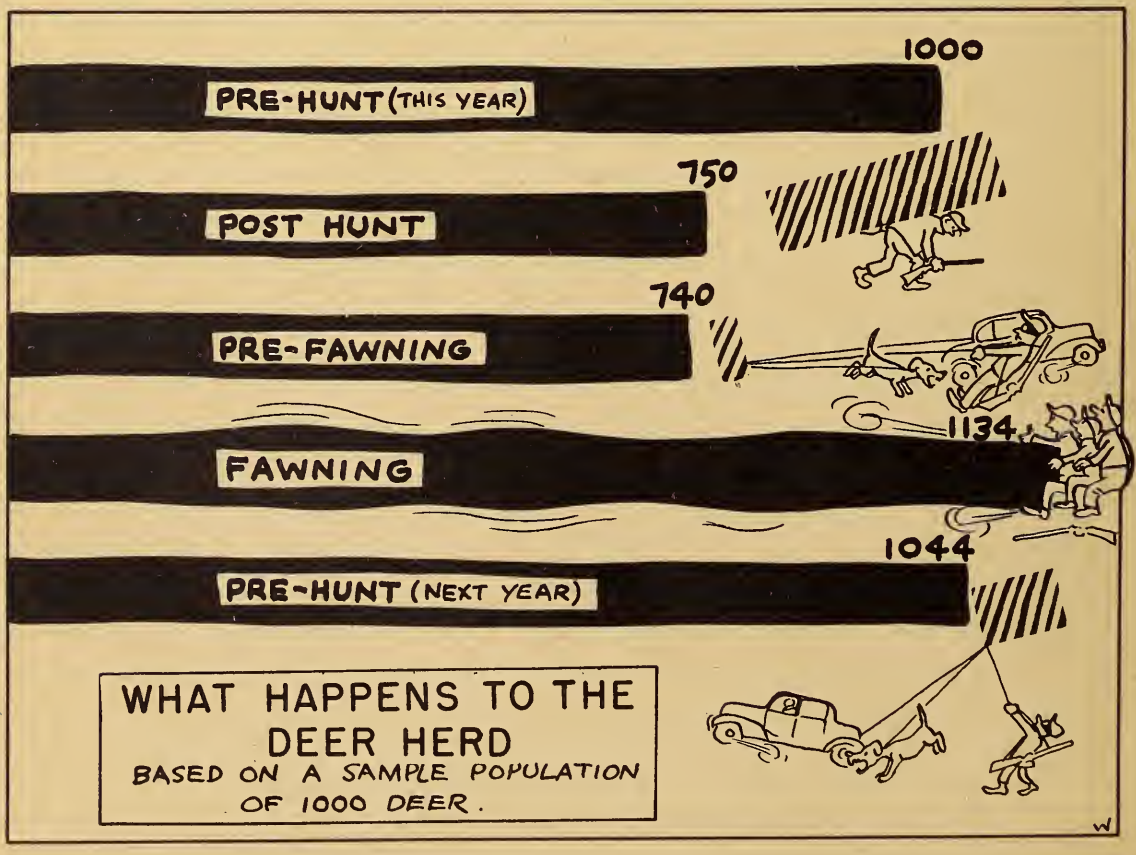


TABLE IX

LIFE EQUATION OF MASSACHUSETTS' DEER HERD
BASED ON A SAMPLE POPULATION OF 1000 DEER

SEASON	DESCRIPTION OF GAINS AND LOSSES	LOSSES	FAWNS BUCKS	FAWNS DOES	ADULTS BUCKS	ADULTS DOES	TOTAL POPULATION
	Pre-hunting season population		205	175	335	285	1,000
Hunting	Legally reported kill	200					
	Kill not reported	30					
	Crippling loss	20					
	Loss	250					
	Post-hunting season population		154	131	251	214	750
Post-hunting	Illegal kill by man	20					
to	Accidental kill	10					
Pre-fawning	Killed by dogs	5					
	Killed damaging crops	5					
	Loss	40					
	Pre-fawning season population		145	125	237	203	710
Fawning	Female fawns x productivity	73					
	Female adults x productivity	349					
	Gain	422					
	Post-fawning season population		228	194	383	327	1,132
Post-fawning	Illegal kill by man	60					
to	Accidental kill	20					
Pre-hunting	Killed by dogs	5					
	Killed damaging crops	5					
	Loss	90					
	Pre-hunting season population		214	182	349	297	1,042
	Total yearly gains	422					
	Total yearly losses	380					
	Annual increase	42 or 4.2 percent					

Practical Use of the Life Equation Table

The legally reported kill in 1950 was 3079. The equation shows that the reported kill makes up about 20 percent of the total population. Multiplying 3079 by 5, would place the total population at about 15,500. Based on the 1949 kill of 4374, the population would be roughly 22,000. It is the authors' belief that somewhere between these two figures rests the present level of the deer population. After a detailed study of the available information at hand, it is believed the figure 20,000 is as close as one can come to the total deer population in Massachusetts prior to the hunting season.

Assuming that 20,000 will be the pre-hunting season population in 1951, the life equation shows that about 25 percent or 5,000 will be removed during the one week open season. Of this 5,000, about 4,000 (20%) are legally reported, 600 (3%) are not reported, and 400 (2%) die unclaimed as a result of wounds. If the figures are reasonably accurate, it follows that hunters could take home 4,600 deer *if* every deer bagged during the season were reported. But since it is estimated that 600 are not reported, the legally reported kill should be around 4,000. It follows, too, that *at least 4,000 legally reported deer can be taken year after year for the next several years and the herd will still show a small average yearly increase.* There may be too many variables in the information at hand to make such a positive statement, but the authors are convinced that future years will prove the statement to be correct.

Since 4,000 legally reported deer is considered to be a safe annual harvest from 1951 on, it would appear that the kill of 4374 in 1949 may have been slightly excessive. The predicted kill in 1950 was 3800, but exceptionally poor weather conditions kept it down to 3079. This low kill naturally means that the 1951 season should go over the 4,000 mark and, with the aid of some tracking snow, could conceivably set a new record-high.

If the trend in the popuation continues as it is now, a four percent increase can be expected each year, providing the deer are not over-shot on any particular year. It may be justifiable now to speculate what the level of the population would be each year for the next ten years if the average yearly increase of four percent continues, and the legally reported kill comprises 20 percent of the total population. Table X gives the forecast. Only time will tell how accurate these figures of population trend may be.

TABLE X

SPECULATED POPULATION TREND IN THE MASSACHUSETTS DEER HERD FOR THE TEN YEAR PERIOD 1951 TO 1960

Year	Population Based on Average Yearly Increase of Four Percent	Open Season Kill Based on Legally Reported Harvest of Twenty Percent
1951	20,000	4,000
1952	20,800	4,160
1953	21,632	4,326
1954	22,497	4,499
1955	23,397	4,679
1956	24,333	4,867
1957	25,306	5,061
1958	26,318	5,264
1959	27,371	5,474
1960	28,466	5,693

It must be remembered that a number of things might happen to upset the trend shown in Table X. Severe winters, loss of range through expanding highway systems, increase in illegal hunting and accidental kills, and excessive open-season kills with the help of "too good" snow conditions are but a few of the factors which could level off the trend.

VIII. What Deer Management Means in Massachusetts

The aim of management is to supply to the hunter a harvestable surplus of deer. This surplus should be increased and maintained at the highest level possible, while the herd is kept healthy and the range in good condition. Experience has shown that with deer range and an adequate breeding stock this can rather easily be accomplished by managing humans. Regulation of the number and sex of deer which may be harvested each year is quite quickly followed by an increase or decrease in deer numbers. States which have adopted the buck law as a management measure have been able to produce an amazing number of deer. Almost without exception, however, those states have soon had such a large deer herd that the range and the herd has been damaged before man could be adequately regulated so as to harvest this surplus. Odd as it may seem the primary aim of deer management in many states today is to reduce the herd rather than increase it.

In order to determine how best to manage the deer herd, then, certain knowledge must be obtained. It is necessary to know the hunting pressure, how many deer there are, where the deer are located, and the condition of the deer range. What this knowledge wise human regulations may be drawn up to maintain the herd at the desired level.

Hunting Pressure

Since Masachusetts does not require a special license to hunt deer, hunting pressure was determined by a post card survey. About 9,300 cards were sent out to a random sample of the 131,188 people who bought hunting licenses of all classifications in 1949. These cards asked if the person

hunted deer in 1949, where he hunted, how long, and if he shot a deer. Four thousand two hundred of these cards were returned. There was apparently a considerable bias in the return of the cards between those who hunted and those who did not. The returns indicated that 61% or about 80,000 of the license holders hunted deer in 1949. Of this 61 percent, 1 in 11 said he killed a deer. The deer kill in 1949 was 4,374; yet if 1 in 11 of the hunters killed deer, 7,277 should have been reported. Put another way, multiplying the number of deer killed by 11 gives about 48,000 hunters. What probably happened was that (1) more deer hunters returned cards than non-deer hunters, and (2) of those who went deer hunting, more successful hunters returned cards than non-successful hunters. An estimate of 65,000 probably represents a more accurate figure than either of the others. Based on this figure, just about half of those who purchased licenses in 1949 hunted deer, and about 1 in 14 was successful, based on the reported kill.

The information obtained from the returned questionnaires shows that the average deer hunter pursued deer for 3 days. If these 65,000 individuals were distributed evenly over the 5265 square miles of deer range, there was an average of 12 to 13 hunters per square mile of deer range. Table XI, which summarizes hunting pressure by regions, shows that this is not so.

TABLE XI

Breakdown of Hunting Pressure by Regions in Massachusetts

County otherwise (unless / noted)	Total Hunters Based on 3 Man Days per Hunter	Hunters per Square Mile of Deer Range	1949 Kill	Hunter Success Ratio
Barnstable	5,000	16	269	1 in 19
Berkshire	7,600	12	983	1 in 8
Bristol	3,200	9	83	1 in 39
Dukes[1]	—	—	—	—
Essex	3,700	14	86	1 in 43
Franklin[2]	10,400	23	754	1 in 14
Hampden	4,700	11	369	1 in 13
Hampshire[3]	3,100	11	307	1 in 10
Middlesex	5,400	12	211	1 in 26
Nantucket	500	20	85	1 in 6
Norfolk	900	3	30	1 in 30
Plymouth	3,900	8	115	1 in 34
Worcester, north[4]	8,000	14	410	1 in 20
Worcester, south	2,200	5	136	1 in 16
Towns around Quabbin Reservation[5]	6,200	31	393	1 in 16

[1] Omitted because of insufficient card returns.
[2] Shutesbury and New Salem included under Quabbin towns.
[3] Pelham, Belchertown and Ware included under Quabbin towns.
[4] Hardwick, Barre and Petersham included under Quabbin towns.
[5] Deer range in Reservation closed to hunting not included in computation of column 2. Small closed areas in rest of State are included as deer range.

It would appear that the hunter could use Table XI as a guide for avoiding heavy hunting pressure and still have an equally good chance of getting a deer. For example: (1) Franklin County has twice as many deer hunters as Hampden County, yet the hunter success ratio is almost the same. (2) The Quabbin Towns have six times as many hunters per square mile of deer range as does Southern Worcester County, yet the hunting success ratio is equally good in each.

These comparisons might be valid if the number of deer per square mile were equal in all sections, but such is not the case. For instance, if the hunting pressure in the Quabbin towns were transferred to Southern Worcester County, it is very likely that the hunter success ratio for this section would decrease considerably, since there are fewer deer per square mile in Southern Worcester County than in the Quabbin towns.

It should be noted that Table XI is based on a sampling method and may not be statistically accurate. It is, however, a much better picture of hunting pressure than has ever been realized before. The only way to get a truly accurate count of the number of deer hunters is to have a special deer license with a separate fee attached.

Regional Abundance of Deer

The center spread map, showing deer hunting areas in Massachusetts, gives a good picture of the regional abundance of deer. The map is based on the reported kill in the towns over a 12 year period expressed in terms of deer killed per square mile of deer range. Even though hunting pressure may have an effect on the kill, the fact that some towns consistently maintain a high kill indicates that they have a good deer population. The actual reported kill by towns and counties for the twelve year period, on which the map is based, is presented in the Appendix.

Value of Sanctuaries

The principal purpose of sanctuaries or refuges is to preserve or increase the desired species usually in areas where they are low in numbers. They are of particular value to the wildlife manager when he wishes to increase the number of animals in an area and still allow hunting in the surrounding territory. That refuges or sanctuaries can be effective is well illustrated by the Quabbin Area, which, although it was not created for this purpose, has in actuality accomplished it.

Approximately 95 square miles of land around the Quabbin reservoir were closed to hunting by 1938 and remain closed as of this writing. Most of this closed area was good deer range and was adequately stocked with

deer. As the water rose in the 39 square miles which were flooded, additional deer were no doubt forced into the closed area, adding to the deer already present. There was then, in the closed area around the reservoir, a large deer herd. The large size of this herd probably hastened the effect of the reservation on the kill of deer in the surrounding towns. This effect rather quickly showed itself. The deer kill in the nine towns* which either border the Quabbin Reservation or are in rather close proximity to it, went from 5 percent of the state kill in 1939 to 27 percent of the kill in 1945 and 1946 — an increase of 22 percent. The kill decreased in 1947 to 18 percent and by 1950 was down to 14 percent. Table XII gives the percentages and kill for each year.

TABLE XII

DEER KILL OF NINE QUABBIN TOWNS 1939-1950

Year	Quabbin Towns	State Kill	Percent of State Kill
1939	105	2100	5.0
1940	284	2067	9.2
1941	166	1773	9.3
1942	283	2532	11.2
1943	437	2422	18.0
1944	525	3060	17.1
1945	872	3567	27.2
1946	566	2803	27.1
1947	726	3886	18.6
1948	287	2344	12.2
1949	526	4374	12.0
1950	461	3079	14.9

In order to understand this rise and fall of the kill, consider what probably takes place in a large refuge. After the area is closed, the deer herd builds up under protection until the numbers inside are larger than the numbers outside. As this build up continues, there is a larger flow of deer from the refuge to outside areas. The larger the herd inside, the greater the number going out. This explains the constantly greater take until 1946, but then why did it decrease?

If a refuge is to be continually productive, it must remain capable of supporting the large populations which create the overflow. McLaughlin, (16) reporting on observations made in 1946, has this to say. "Observations within the Reservation show that some of the area is at the present overbrowsed and that much of the rest of it is in danger of becoming overbrowsed. A widespread overbrowsing combined with a lack of the regeneration which follows cutting will quickly end its producive power." This apparently has taken place on some of the area, as will be shown shortly, with a resultant decrease in the overflow to the surrounding towns.

The above discussion illustrates rather well the idea that if large blocks of deer range are closed to hunting, the deer population will increase and spread to adjoining areas. It also points out that these areas should not be closed for long periods of time but rather should be opened to hunting as soon as signs of heavy browsing are noticed. As a management measure, refuges could be used to increase deer populations in areas not adequately supplied or in areas where heavy hunting pressure keeps the deer herd at a low point.

Effect of Deer Browsing on Forest Reproduction

A survey was made to determine if deer browsing in sanctuaries and other closed areas was holding back reproduction of timber species to an extent considered dangerous to the future welfare of the forests. The survey was

* Petersham, Pelham, Shutesbury, New Salem, Wendell, Hardwick, Barre, Ware, and Belchertown.

made in sanctuaries in various regions of the State. These were picked with the thought that deer populations there were at least as large as in open areas and that if browsing conditions were all right from a forestry standpoint, certainly the State deer range as a whole would be in good shape. The method used in the survey was briefly as follows:

At each area a compass line was established, which would give a typical cross section of the various forest types. Plots 66 feet long and 6.6 feet wide spaced at 122 foot intervals were examined along this line. At each study area thirty of these plots were examined. Thus 3 acres of forest reproduction along a line 1.1 miles long were studied. Every woody plant between one and six feet in height occuring in these plots was examined and the browse condition recorded. All of the study areas were closed to hunting except the one at Harvard Forest. Table XIII gives the summary.

TABLE XIII

Effect of Deer Browsing on Forest Reproduction in Area of Comparatively High Deer Populations in Massachusetts

Area	Number of Specimens	Percent Heavily Browsed*	Percent Lightly Browsed**	Total Percent Browsed	Total Percent Unbrowsed
Quabbin Reservation, West Side	1264	30.5	33.9	64.4	35.6
State Sanctuary in Hawley	748	18.9	43.0	61.9	38.1
Quabbin Reservation, East Side	1296	16.8	36.4	53.2	46.8
State Sanctuary in Monterey	1111	11.9	37.3	49.2	50.8
State Sanctuary in Ipswich	1539	7.5	30.3	37.8	62.2
State Sanctuary in Brimfield	1392	2.2	31.7	33.9	66.2
Harvard Forest in Petersham	1419	4.3	25.0	29.3	70.7
State Sanctuary in Freetown	2031	0.6	18.0	19.5	80.5

* If terminal leader or 2/3 or more of crown browsed, specimen tallied as heavily browsed.
** If browsing occurred but terminal leader present and less than 2/3 of crown browsed, specimen tallied as lightly browsed.

The areas in Table XIII are arranged according to the total percent browsed, so it probably follows that they are also listed according to deer abundance. It might be inferred, then, that the west side of the Quabbin Reservation supports three times as many deer as the Freetown Sanctuary, since three times as much browsing occurs. There are no population statistics to support this contention; however, it is probably close to the truth.

For the purpose of determining the loss of forest reproduction, only the heavily browsed percentages are considered, since if these areas continue to be browsed to the same extent they will be permanently suppressed. The area at the west side of Quabbin showed the largest percentage of heavily-browsed specimens. Thirty percent of the specimens examined there will not develop into healthy trees, 70 percent will. Seventy percent of 1264 specimens gives 885 future trees on three acres or 295 per acre. In areas of heavy maturing overstory, such as exists on this area, a forester would normally expect between 200 and 300 stems of reproduction per acre in order to insure normal forest growth (30). At the heaviest-browsed area, then, there are 269 stems per acre not counting those under one foot which were not tallied during the study. Apparently the closed areas in Massachusetts are not over-stocked with deer from the forester's standpoint with the exception of Prescott Peninsula in New Salem. Jones, (12) made a special browse study there in 1950 and found that sixty-nine percent of the commercially important species were heavily browsed. He concludes that the forest is being badly damaged and that a quick reduction of the deer herd is mandatory.

FIGURE 9.

Deer browse line on hemlock. Heavy browsing usually indicates that deer numbers are heavy and that reduction of the herd in the area is necessary. Very few instances of over-population have been found in Massachusetts.

The one possible exception from the list in Table XIII is Hawley where now about 200 stems per acre are escaping serious deer damage. The dense overstory of mature trees is resulting in fewer reproductive stems per acre. What is needed there more than deer reduction is a harvesting of the over-mature trees to allow more sunlight and more reproduction to get started.

Red maple is a preferred deer food. This one species has been singled out for presentation in Table XIV for comparison with browsing conditions in Wisconsin, where a survey quite similar to this one was conducted. It was also the one species represented by quite a few samples at all check areas and gives a good comparison by areas. Areas are arranged according to amount of heavy browse.

In Wisconsin, for comparison, 60 percent of the maple were browsed heavily in the northwest area, 65 percent in the northeast area, and 75 percent in the central area. (30) Massachusetts' heaviest-browsed area shows only 42 percent, while Wisconsin data represents state-wide forest conditions, practically all open to hunting, but usually with a buck law. This is a good example of the bad effects of the buck law on healthy forest growth. Massachusetts is fortunate in never having had the buck law forced upon it.

Conclusions on the whole browse study are that the Quabbin areas and possibly the Hawley and Monterey areas should be re-studied in about three years to see if browsing conditions are getting any worse. This could be done by district personnel. Even now, light hunting would be a good idea, possibly with bows and arrows. If not, every few years the above sanctuaries could be opened to controlled hunting. The Prescott Peninsula should be opened to some sort of controlled hunting just as soon as arrangements can be worked out. The Hawley wildlife area should have a thorough job of selective cutting.

Limited Hunting in Closed Areas

McLaughlin, (15) suggests several ways of removing deer from areas closed to hunting. From experience in other States, he concludes that limited gun hunting with special permits is the most practical way to solve the problem.

But in the last few years the sport of hunting with bow and arrow has increased greatly and may well be the best way to control deer populations on closed areas. Special permits would not need to be issued, since the possibilities of over harvesting would be minimized, and the danger of accidental shooting largely eliminated. There is, however, a possibility that this method might not cause a sufficient harvest to solve the problem. The Quabbin's Prescott Peninsula would be an ideal place to try out the effectiveness of bow hunting in closed areas.

TABLE XIV

Effect of Deer Browsing on Red Maple Reproduction in Areas of Comparatively High Deer Populations in Massachusetts

Area	Number of Specimens	Percent Heavily Browsed	Percent Lightly Browsed	Total Percent Browsed	Total Percent Unbrowsed
Quabbin Reservation, West Side	203	42.4	31.0	73.4	26.6
Quabbin Reservation, East Side	114	30.7	31.6	62.3	37.7
State Sanctuary in Hawley	47	21.3	40.4	61.7	38.3
State Sanctuary in Freetown	54	9.2	16.7	25.9	74.1
State Sanctuary in Monterey	64	7.8	37.5	45.3	54.7
Harvard Forest in Petersham	95	5.4	30.5	35.8	64.2
State Sanctuary in Ipswich	194	4.6	32.5	37.1	63.9
State Sanctuary in Brimfield	178	2.8	28.8	30.9	69.1

Hunting with bow and arrow is presently allowed in Massachusetts during the one week open season. However, questionnaires sent to 17 states where bow hunting is a popular sport showed the following sentiments concerning the season: (a) 12 states thought the bow season should be separate from the regular gun season; (b) 11 states believed bow hunting should be restricted to specific areas, not state-wide; and (c) 12 states thought the bow season should come before the regular gun season, not during or after. These majority sentiments from men who have had experience with bow hunters should carry some weight and should be considered in determining any future bow and arrow legislation.

Crop Damage

The state adopted a generous policy in 1903 of reimbursing farmers for damage to their crops. Since then well over $300,000 has been paid out, an average of about $7,000 per year. The largest amount paid in any one year was $20,000 in 1913. A special study of damage payments between 1939 and 1945 (11) showed little relationship between numbers of deer and amount of damage. The five western counties, including Worcester, showed 80 percent of the deer kill but only 57 percent of the damage claims. The five eastern mainland counties produced only 20 percent of the kill but 42 percent of the claims. It would seem from these figures that any attempt to reduce the amount of claims through increased hunting pressure would not be particulary effective unless the deer herd was very drastically reduced.

Principal crops damaged may be roughly estimated in percentage of claims as follows (11): orchards 40%, strawberries 10%, beans 10%, lettuce, cabbage and cauliflower 10%, root crops such as carrots 10%, vine crops such as melons 10%, and all other crops 10%.

Under the current law, claims less than $20.00 are appraised by the Chairman of Selectmen in towns, and by the Chief of Police in cities. During the period 1939-45, 390 small claims were approved, which represented 73 percent of all claims, but only 20 percent of the total payments (11). Until 1949 claims over $20.00 were appraised by a board consisting of one representative of the landowner, one representative of the Division of Fisheries and Game (usually District Conservation Officer), and one representative of the County Agricultural Agency. Since 1949, in order to enforce the use of a standard schedule for vegetable damage and bring about a uniformity of award in all counties, the Division has been represented by a single representative, who devotes almost full time to the deer damage problem.

Indices of Over-Population

The effect of an over-abundance of deer on forest reproduction has already been covered. Too many deer also have a bad effect on the deer themselves. A special study at Naushon Island (29) off Woods Hole showed that too many deer result in smaller, lighter deer with females producing fewer off-spring, all because of a shortage of food. The complete Naushon study is written up and available by writing to Upton, therefore only the summary to the report will be given here. Shaw writes:

> ". . . too many deer have a detrimental effect on both the condition of the deer and the condition of the range. Undernourished deer from a 6,000 acre Island (Naushon) where hunting pressure was negligible were compared in weight, size, and reproductive capacity with well-fed deer from a 16,000 acre Island (Nantucket) where hunting pressure was heavy. It was found that deer from the poor range averaged 32 pounds lighter, 14 percent smaller in skeletal size, and produced only 60 percent as many fawns as deer from the range with adequate food . . . The age composition of the deer from the heavily-hunted Island showed that about 35 percent of the total population was being removed each year. Ages of deer from the other herd showed an even distribution from the youngest to the oldest, indicating that many young animals died from lack of nourishment."

A similar study on the Prescott Peninsula showed that deer there were slightly lighter and produced slightly fewer fawns, but the evidence was not conclusive enough to state definitely that an over-population was as yet seriously upsetting the condition of the deer. But, as pointed out previously, Jones' browse survey in the area did show that the range was overbrowsed. And McLaughlin, working in the same area in 1946, concluded that the herd should be reduced (15).

These studies should be taken as warning signs that too many deer should not be tolerated throughout the general deer range in Massachusetts. The only way to keep the herd in balance is to continue the heavy annual harvests of both bucks and does, and somehow to thin out the population in present problem areas now closed to hunting. Prescott Peninsula is the shining example.

Deer Management in Massachusetts Compared with That in Other States and Provinces

How does our management compare with deer management in other places within the white-tail's range in North America? *Very well* is a truthful answer we can be proud of. It all results from the fact that Massachusetts is removing its surplus each year, whereas most of the other States and Provinces are not. Bartlett(3) summarized the status of white-tailed deer in United States and Canada. Some quotes from his published paper follow:

"*Hunters.* There were 2,800,000 hunters on the 1,200,000 square miles of well-populated range open to hunting in 1947. The recent great increase in the deer herd has been paralleled by a comparable increase in the number of hunters. In Michigan, for example, there were 75,000 hunters in 1930, 175,000 in 1940, and 375,000 in 1948. A similar increase has occurred in many states and provinces.

"The hunting pressure over the entire 1,200,000 square miles averaged two and one-third hunters per square mile in 1947. Hunting pressures pyramid in certain local areas, reaching astonishing levels. In Michigan, Roscommon County had 45 deer hunters per square mile in 1946. Roscommon and a number of adjacent counties have averaged more than 25 hunters per square mile for many years. These conditions are duplicated in numerous states where deer hunting occurs within easy driving distance of large metropolitan centers.

"Kill-1947. The white-tail deer herd is estimated at 6,000,000 head. Game men from the various states and provinces estimated the harvestable surplus at 1,100,000 head or 18 per cent of the herd in 1947. Theoretically then this is the number of deer that should have been killed by hunters. However, such was not the case.

"There was no open season in 13 states and provinces, 28 states and provinces limited the take to antlered deer only, and in 16 both antlered and antlerless deer were taken.

"What then happened to the 460,000 animals comprising the unharvested portion of the harvestable surplus? These "extra" surplus deer probably would fall into three classifications. They died of starvation, were shot by farmers while destroying crops, or stayed with the rest of the herd to destroy more of their range. . . .

". . . Can we logically call ourselves 'conservationists' when, with a valuable resource such as white-tail deer, we take only 58 percent of the harvestable crop and waste the other 42 percent? It is deplorable, in countries as supposedly progressive as the United States and Canada, that deer

are allowed to starve, or be shot by farmers because of crop damage."

Bartlett's attacks were aimed primarily at states which continuously practice the buck law. It should do his heart good to realize that Massachusetts removes between 20 and 25 percent of its crop each year through the open season.

Hunting pressure in Massachusetts is about five times as great as the average given above. There are an estimated 65,000 hunters going after a deer herd of about 20,000, and both bucks and does can be shot indiscriminately, yet a slight yearly increase in the deer population is still evident. These facts should be of considerable value to many states faced with deer problems.

IX. Recommendations for Changes in Laws

Since deer management is mostly human management this bulletin would hardly be complete without a review of the present regulations which should be changed or revised and recommendations for new laws.

Changes in Present Laws

The Director of the Division of Fisheries and Game may at present extend the season for an additional week in the four Western Counties — Berkshire, Franklin, Hampden, and Hampshire. He may also suspend or modify, subject to the approval of the governor and council, in whole or in part the open season when he considers it necessary.

It is suggested that the Director be given the power to extend the season for one week in any county or counties in the state. With the deer herd continually increasing and extending its range throughout the State it may be desirable in the future to take more of the herd than is possible during one week. If this occurs it may as easily occur in some of the Eastern Counties as in the Western.

The Director of Law Enforcement agents may kill a dog found chasing or hunting deer if the dog is so doing with the knowledge and consent of the owner. If the owner has twice been notified that the dog has been found chasing or hunting deer it shall be considered that the dog was doing so with the consent of the owner.

In one month 20 of the 30 deer which were brought to the deer project for examination had been killed by dogs! It is obvious that the great majority of deer killed directly or indirectly by dogs are never brought to the attention of any authority since many of these kills are made in the woods, during the late winter, when few people are afield.

The object of management is to create and maintain a surplus of animals to be harvested by man. The size of this surplus is determined by, among other things, the number of deer which are available as breeding stock. If dogs are allowed to take a good portion of this breeding stock, the surplus available to the hunter is going to be just that much smaller.

The present law gives the dog the best of the bargain since it is almost impossible to identify dogs running deer and to determine their ownership. It is recommended that a committee, such as was formed in New York, composed of representatives from the departments of agriculture, health, and conservation, the council of sportsmen's clubs, and the association of town officers, be formed to study damage by dogs and make recommendations for changes in the law.

New Regulations

Information has been presented previously which points out that an estimated eight percent of the deer killed each year are killed illegally and that another three percent are never reported. If this illegal kill could be controlled, the law abiding hunters who now take 20 percent of the herd could take 31 percent of the deer.

It is suggested that each deer hunter be required to purchase a special deer license which will come in three sections. The issuing agent will retain one section containing the hunter's name, the license number of both his regular hunting license and his deer license, and the towns in which he intends to hunt. Another section will be an addressed, prepaid postcard for reporting the kill. The third section will be the hunters special deer license attached to which will be a self-locking metal seal to be locked around the hind leg of a deer immediately after the kill.

This type of license would greatly aid in law enforcement since any deer found not tagged would be considered illegal. Any hunter found hunting deer without both license and unlocked seal bearing identical numbers would be doing so illegally. This would prevent a hunter from getting more than one deer and recording it under someone else's license. Further if all hunting, except deer hunting, were prohibited during deer week, any person found hunting without an unlocked seal would be doing so illegally.

A special deer license of this sort would be of great use to the game manager also. Stubs turned in by the issuing agent would show the total number of deer hunters afield during the hunting season as well as the general distribution of these hunters. This information, combined with the kill figures by towns, will show the hunter-success by regions and indicate which areas are over hunted and which could stand more hunting pressure. Without information of this type intelligent management cannot be applied.

It should be emphasized that as long as illegal hunting of deer is allowed to continue the sportsman is going to have less chance of getting his deer.

X. Summary

Introduction and History

What is the value of the deer herd to the residents of Masachusetts?
The deer herd is directly valued at over 17 million dollars. This is over $5.00 for each acre of deer range.

How much meat does the hunter obtain from the average deer?
The average deer weighs 102 pounds hog-dressed and furnishes about 76 pounds of edible meat.

How can Massachusetts determine the condition of its deer herd?
By using the data collected at checking stations it is possible to tell whether the population is rising, falling or remaining stable. Weights and measurements determine the relative health of the deer.

What was the status of the deer herd 100 years ago?
In 1850 deer were almost completely gone from Masachusetts. There were a few deer in Barnstable and Berkshire Counties.

Was the hunting of deer ever prohibited in Massachusetts?
Yes. There were no open seasons between 1898 and 1910.

Did Massachusetts ever have a "buck law"?
No. Hunters have always been allowed to take any deer regardless of sex or size.

How many bucks and does have been shot since 1910?
Over 40,500 bucks and 34,000 does.

Is the deer herd increasing?
The herd continues to increase each year in spite of increasing hunting pressure.

Environmental Influences

Does weather have much effect on the deer?
No. Only when snow depths of over 20 inches cover the ground for at least five weeks are the deer in danger. Fortunately, these conditions occur quite infrequently and are not usually serious then because the deer and most of the range are in good condition.

How much of the state is considered to be deer range?
The 5265 square miles of woodland or about two-thirds of the State's land area.

What effect do soils and soil fertility have on the deer?
This subject has never been thoroughly explored but there is evidence of a close relationship between the soil and the quantity and quality of game species.

How have changes in land utilization influenced the deer herd?
In 1880 about two-thirds of the land area was devoted to farming. At the present only about 38 percent is in farms. This means that in the last 70 years about 26 percent of the State has changed from farm land to forest or brush land. These reverting areas provide favorable conditions for deer and have expanded their range and indirectly their numbers.

Are Massachusetts' forests considered good deer habitat?
Yes. Past and present lumbering operations combined with reverting farm lands have produced uneven aged forests which provide a maximum of food and cover. Continuous cuttings, provide deer food and make good range if adequate trees are left for cover and shelter.

Checking Stations

How many deer checking stations does the state expect to keep on a more or less permanent basis?

In order to secure an adequate sample and one which is representative of the state, 15 deer checking stations are recommended. (see list in Chapter IV)

How is the age of a deer determined?

It is possible to tell the age of a deer by examining its teeth.

Can a deer be aged by the number of points on its antlers?

Not with any degree of accuracy. Yearlings with six points and old deer with four are not uncommon. Age and number of points have no consistent relationship.

Life History

How long do deer live?

It is doubtful if any deer living in the wild will live beyond 15 years.

Do hunters take the same number of bucks and does?

No. Over the years they have reported a take of 54 bucks to every 46 does.

How much does an average deer weigh?

Weight alone does not mean much unless it is related to the deer's sex and age. For instance, the average 4½-year-old buck weighs 208 pounds while the average 4½-year-old doe weighs only 142 pounds.

Are Massachusetts deer becoming stunted because of inbreeding?

There is no evidence to indicate that the Massachusetts deer are becoming smaller. They compare very favorably with deer from Maine.

When do deer reach their maximum skeletal size?

Measurements taken at checking stations indicate that does reach their maximum size at 3½ years and bucks at 5½ years.

Do female deer ever have antlers?

Occasionally a doe will have antlers, although it is not common.

When do deer breed?

Most of the adult does are bred in November, the fawn does in December.

How many fawns does a doe produce each year?

This depends on the age of the deer but it can be generally said that fawn does produce a single fawn, two-thirds of the yearling does produce twins, and three quarters of the adults produce twins or triplets.

When are the fawns born?

Most of the fawns are born between May 24 and June 8.

Are the deer healthy?

Massachusetts' deer seem to be relatively free from harmful parasites or diseases.

What do the deer eat?

The deer is chiefly a browser and its principle food is composed of woody or herbaceous plants, supplemented by fruits and nuts in season.

Fallow Deer

What is the newest game animal in Massachusetts?

The fallow deer which were introduced in Martha's Vineyard in 1932.

Should the fallow deer be stocked on the mainland?

No stocking of fallow deer should be attempted until further information has been obtained on the ability of this animal to withstand hunting and

its affect on the native deer. Furthermore the mainland is already well stocked with the native white-tail.

Population Factors

How many deer are removed from the deer herd each year from all causes?

An average of 38 percent of the deer herd is removed each year. Hunters take about 25 percent, the other 13 percent being removed by dogs, accidents, and illegal killing.

What is the average production of the deer herd each year?

The deer herd produces about 42.2 percent of its total numbers each year. This figure minus the 38 percent removed each year gives an average increase of 4 percent.

How many deer are there in Massachusetts?

All the information available indicates that there are close to 20,000 deer in the herd prior to the hunting season.

Management

How many deer can be shot each year under present conditions without damaging the deer herd?

Between 4,000 and 4,500 for the next few years.

How many sportsmen hunt deer each year?

No accurate figures are obtainable without a special deer license but a post card survey indicated that about 65,000 sportsmen hunt deer each year.

What is the purpose of sanctuaries or refuges?

Their principle purpose is to preserve or increase the deer in areas where they are low in numbers.

Do refuges have an effect on the deer kill in the open areas?

Yes. The deer kill in the towns surrounding the Quabbin Reservation increased from 5 percent of the State kill in 1939 to 27 percent in 1945 and 1946.

How long are deer refuges effective in increasing the kill in the open areas?

Only as long as the refuge is able to support and produce large numbers of deer. Observations made in parts of the Quabbin Reservoir indicate that this area is being heavily browsed and is not presently able to support its formerly large deer populations. The fact that the kill in the surrounding towns has declined in the last few years tends to support this contention.

Should a refuge remain closed to hunting indefinitely?

No. As soon as it looses its ability to support the deer without damage to browse it should be periodically opened.

What is the most practical way to permit hunting on closed areas?

With bow and arrow! This eliminates the need for special permits, since the possibilities of over harvest are minimized and the danger of hunting accidents is largely eliminated.

How much money does the State pay each year for deer damage to crops?

Since 1903 an average of $7,000 a year has been paid to landowners.

What are the principal crops damaged by deer?

Apples, strawberries, and vegetables.

Should the Director of the Division of Fisheries and Game be allowed to open the season for an additional week if it becomes necessary?

Yes. The present law allows him to do so in four counties but it should be changed to include all counties. With an increasing deer herd it may be necessary in the future to increase the harvest. All counties now have deer and the need for a longer season may well occur in some of the eastern counties.

Do dogs take many deer?

There is evidence that dogs take many deer each year and, next to man, are the deer's greatest predator. The present dog law makes it very difficult to stop the loss of deer to dogs. It is recommended that a committee be formed to determine needed revisions in this law.

Why is a special deer license needed?

As an aid to both law enforcement and management personnel. A license of this type would greatly reduce the illegal kill of deer during the hunting season and assure that a hunter could take only one deer. The number of deer hunters would be known which would aid management men in applying intelligent deer management.

Why is a deer tag law so important?

Because it will reduce the amount of illegal kill thereby giving the law-abiding hunter a greater chance to shoot a deer.

Bibliography

1. Allen, G. M. *1929. History of the Virginia deer in New England. Trans. New Eng. Game Confer., pp. 19-41.*
2. Anon. *1945. A few Massachusetts forest facts. Mass. Dept. Conserv., Div. Forestry.*
3. Bartlett, I. H. *1949. Whitetail deer resources. United States and Canada. Trans. 14th N. A. Wildl. Confer., pp. 543-553.*
4. Bartlett, I. H. *1950. Michigan deer. Game Div., Mich. Dept. Conserv.*
5. Beaumont, A. B. *1943. A key to Massachusetts soils. Exten. Serv., Univ. of Mass., Spec. Circ. 64.*
6. Cheatum, E. L. and G. H. Morton. *1946. Breeding season of white-tailed deer in New York. Jour. Wildl. Mangt. 10 (3): 249-263.*
7. Cheatum, E. L. *1949. The use of corpora lutea for determining ovulation incidence and variations in the fertility of white-tailed deer. Cornell Veterinarian, 39 (3): 282-291.*
8. Dangler, E. W. *1948. Woods dressed weights of 150 Maine deer shot in November 1948. Maine Div. Inland Fish and Game, unpubl.*
9. Gerstell, R. *1936. Breeding experiments with the whitetail deer. Pa. Game News, 6 (12): 4, 20.*
10. Gordon, A. and A. W. Sampson. *1939. Composition of common California foothill plants as a factor in range management. Univ. Calif. Agric. Exp. Sta., Bull. 627.*
11. Hager, J. A. and C. L. McLaughlin. *1946. Deer damage claims. Mass. Div. Fisheries and Game, unpubl.*
12. Jones, W. L. *1950. The deer herd of Prescott Pensinula, Quabbin Reservation, and its ecology. M.S. Thesis, University of Mass. unpubl.*
13. Latham, R. M. *1950. Pennsylvania's deer problem. Pa. Game News, Spec. Issue No. 1.*
14. McLaughlin, C. L. *1946. Deer kill and population. Mass. Div. Fisheries and Game, unpubl.*
15. McLaughlin, C. L. *1946. Deer populations and damage to browse on the Quabbin Peninsula. Mass. Div. Fisheries and Game, unpubl.*
16. McLaughlin, C. L. *1948. The effect of the Quabbin Reservation on deer populations in the adjacent towns. Proceedings 1948 Northeastern Game Conf. pp. 38-40.*
17. Mitchell, H. L. and N. W. Hosley. *1936. Differential browsing by deer on plots variously fertilized. Black Rock Forest Papers, 1 (5): 24-27.*
18. Morton, G. H. *and* E. L. Cheatum. *1946. Regional differences in breeding potential of white-tailed deer in New York. Jour. Wildl. Mangt., 10 (3): 242-248.*
19. Palmer, W. *1949. Woods dressed weights of 222 Maine deer. Maine Div. Inland Fish and Game, unpubl.*
20. Richter, C. P. *1943. Self selection of diets. Essays in Biology in Honor of H. M. Evans. Berkeley Univ. Calif. Press, pp. 499-506.*
21. Rozman, D. *1941. Interrelationship of land uses in rural Massachusetts. Mass. Agric. Exper. Sta., Bull. 387.*
22. Severinghaus, C. W. *1947. Relationship of weather to winter mortality and population levels among deer in the Adirondack region of New York. Trans. 12th N. A. Wildl. Confer., pp. 212-223.*
23. Severinghaus, C. W. *1949. Tooth development and wear as criteria of age in white-tailed deer. Jour. Wildl. Mangt., 13 (4): 195-216.*
24. Severinghaus, C. W. *1949. The live weight-dressed weight and live weight-edible meat relationships. N. Y. State Conservationist, 4 (2): 26.*
25. Severinghaus, C. W., H. F. Maguire, R. A. Cookingham, and J. E. Tanck. *1950. Variations by age class in the antler beam diameters of white-tailed deer related to range conditions. Trans. 15th N. A. Wildl. Conf., pp. 551-570.*
26. Severinghaus, C. W. and J. E. Tanck. *1950. Condition of the mandibular teeth of sixteen and a half year old white tailed deer. Jour. Wildl. Mangt., 14 (4): 382-384.*

27. Shaw, S. P. *1948-49-50-51. Quarterly progress reports dated Oct. 1948, Jan. Jan. 1949, April 1949, July 1949, Oct. 1949, Jan. 1950, April 1950, July 1950, Oct. 1950, and Jan. 1951.*

28. Shaw, S. P. *1950. Deer management in Massachusetts. Mass. Fish and Game Assn., Your Field Sports, 3 (5): 2, 4, 5.*

29. Shaw, S. P. *1951. The effect of insufficient harvests on an Island deer herd. Proc. Northeast Fish and Wildl. Confer.*

30. Swift, E. *1948. Wisconsin's deer damage to forest reproduction survey — final report. Wisc. Conserv. Dept., Publ. 347.*

31. Trippensee, R. W. *1948. Wildlife management. Upland game and general principles, McGraw-Hill.*

32. Wislocki, G. B. *1943. Studies on growth of deer antlers. II Seasonal changes in the male reproductive tract of the Virginia deer (Odocoileus virginianus borealis) with a discussion of the factors controlling the antler-gonad periodicity. Essays in Biology in Honor of H. M. Evans, Berkeley Univ. Calif. Press, pp. 631-653.*

33. Wislocki, G. B., J. C. Aub and C. M. Waldo. *1947. The effects of gonadectomy and the administration of testosterone propionate on the growth of antlers in male and female deer. Endocrinology, 40 (3): 202-224.*

34. Wislocki, G. B. *1950. Personal letter dated February 13, 1950 signed by G. F. Odland.*

Massachusetts Deer Kill By Townships and Counties

1939 - 1950

COUNTY Townships	Twelve Year's Legally-Reported Kill													Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total			
Barnstable																
Barnstable	5	17	18	20	17	26	11	28	17	13	14	12	198	16.5	31,523	.34
Bourne	10	6	10	11	13	18	8	21	14	6	5	13	135	11.3	23,529	.31
Brewster	24	31	18	28	28	64	34	48	39	36	52	49	451	37.6	12,298	1.96
Chatham	6	7	3	1	4	3	5	6	8	3	1	11	58	4.8	6,361	.48
Dennis	13	15	6	13	15	17	24	19	14	10	16	10	172	14.3	11,102	.83
Eastham	18	18	13	14	5	8	11	17	26	9	15	9	163	13.6	5,384	1.61
Falmouth	16	19	37	24	25	33	34	6	32	25	35	56	342	28.5	22,710	.80
Harwich	24	15	14	15	20	25	26	20	13	18	24	18	232	19.3	10,779	1.15
Mashpee	4	5	5	6	6	7	3	7	6	7	5	4	65	5.4	14,889	.23
Orleans	12	13	10	11	8	20	13	16	11	18	20	18	170	14.2	6,923	1.32
Provincetown	0	0	0	1	0	1	3	2	3	0	0	0	10	.8	917	.56
Sandwich	0	9	13	3	16	23	18	25	34	18	16	34	209	17.4	22,244	.50
Truro	29	28	19	16	26	24	18	45	24	29	28	23	309	25.8	6,583	2.50
Wellfleet	16	18	20	18	17	29	36	47	44	28	19	36	328	27.3	5,659	3.13
Yarmouth	3	8	13	4	25	29	21	23	20	15	13	20	194	16.2	13,221	.78
No Town Stated	24	0	4	1	10	0	12	3	2	4	6	10	76	6.3	—	—
Totals and Averages	204	209	203	186	235	327	277	333	307	239	269	323	3,112	259.3	194,122	.85
Berkshire																
Adams	0	1	0	4	0	0	0	0	0	0	6	2	13	1.1	8,861	.79
Alford	6	12	4	12	17	28	30	2	7	8	9	17	152	12.7	5,107	1.59
Becket	39	40	21	45	25	46	33	24	44	41	78	55	491	40.9	26,087	1.01
Cheshire	6	1	2	11	1	3	1	1	4	0	14	6	50	4.2	9,751	.28
Clarksburg	2	2	0	0	0	1	0	1	0	2	2	0	10	.8	6,095	.08
Dalton	1	5	2	3	1	1	1	0	0	4	3	3	24	2.0	9,935	.13
Egremont	12	18	13	12	12	19	16	6	20	19	18	7	172	14.3	6,994	1.32
Florida	9	13	4	10	7	8	15	24	31	33	24	27	205	17.1	13,411	.81
Gt. Barrington	10	22	14	9	13	18	16	14	16	16	33	22	203	16.9	19,253	.56
Hancock	13	43	9	19	25	22	22	5	17	20	56	41	292	24.3	17,407	.89
Hinsdale	0	0	0	3	3	1	4	0	7	2	26	8	54	4.5	9,128	.32
Lanesborough	3	2	6	6	4	6	10	3	5	6	17	13	81	6.6	11,480	.37
Lee	24	23	6	15	4	20	20	18	26	11	28	21	216	18.0	12,129	.95
Lenox	0	0	0	1	4	2	6	0	8	0	1	1	23	1.9	7,459	.16
Monterey	41	45	24	58	47	65	40	28	48	43	62	47	548	45.7	13,302	2.22
Mt. Washington	43	35	27	30	29	35	30	45	41	32	53	44	444	37.0	13,040	1.82
New Ashford	6	9	6	19	5	7	11	5	9	2	10	6	95	7.9	7,191	.70
New Marlborough	40	68	42	49	26	53	39	26	34	22	46	32	477	39.8	20,100	1.26
North Adams	1	6	0	0	0	1	1	1	6	1	3	3	23	1.9	8,749	.14
Otis	46	65	45	67	50	48	43	38	87	59	92	61	701	58.4	20,220	1.85

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY Townships	Twelve Year's Legally-Reported Kill															
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total	Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
Berkshire (cont.)																
Peru	9	11	13	17	2	6	4	3	11	9	23	3	111	9.3	15,393	.39
Pittsfield	2	6	19	8	3	9	1	1	6	7	5	7	74	6.2	12,783	.31
Richmond	6	8	6	5	0	5	6	4	5	4	16	11	76	6.3	4,986	.81
Sandisfield	85	115	92	99	88	103	83	75	76	63	86	68	1,033	86.1	27,307	2.00
Savoy	11	9	7	7	5	7	8	32	22	14	26	29	177	14.8	19,523	.49
Sheffield	13	18	6	23	8	21	23	15	14	8	25	28	202	16.8	15,126	.71
Stockbridge	0	8	8	5	10	14	12	8	13	11	22	10	121	10.1	9,151	.70
Tyringham	10	8	19	21	8	18	11	17	28	14	34	29	217	18.1	8,531	1.35
Washington	12	8	0	8	10	4	11	10	21	10	32	18	144	12.0	21,787	.35
West Stockbridge	16	12	0	8	3	12	7	5	17	3	12	5	100	8.3	6,974	.76
Williamstown	13	68	22	41	93	60	33	46	44	30	59	42	551	45.9	17,735	1.67
Windsor	6	7	3	5	6	7	10	10	24	24	44	33	179	14.9	16,790	.57
No Town Stated	46	19	12	9	18	9	14	20	8	11	18	23	207	17.3	—	—
Totals and Averages	531	707	432	629	527	659	561	487	699	529	983	722	7,466	622.2	421,785	.94
Bristol																
Acushnet	2	0	2	3	0	0	4	0	1	1	0	2	15	1.3	8,402	.09
Attleboro	0	0	0	1	4	0	1	0	0	1	0	0	7	.6	10,476	.04
Berkley	9	4	1	2	4	6	2	3	7	2	9	3	52	4.3	5,794	.48
Dartmouth	7	11	6	7	12	6	12	11	7	6	11	1	97	8.1	26,751	.19
Dighton	1	5	4	9	2	3	0	1	4	0	0	0	29	2.4	9,369	.16
Easton	0	0	0	1	1	0	1	2	5	0	9	2	21	1.8	13,585	.08
Fairhaven	0	0	0	0	0	0	0	0	0	0	0	0	0	—	3,764	—
Fall River	7	7	5	6	4	12	0	6	5	0	4	1	57	4.8	13,835	.22
Freetown	27	53	42	52	52	73	55	42	28	21	33	11	489	40.8	17,761	1.47
Mansfield	0	0	0	1	2	2	0	2	1	1	2	0	11	.9	9,958	.06
New Bedford	1	2	0	0	0	1	0	0	2	0	2	1	9	.8	7,468	.07
No. Attleboro	0	0	0	0	0	0	1	0	0	0	0	0	1	.1	7,930	.01
Norton	0	3	2	1	3	2	4	0	1	1	3	2	22	1.8	12,992	.09
Raynham	0	0	0	0	0	1	2	4	2	2	5	1	17	1.4	7,254	.12
Rehoboth	0	0	0	2	1	1	2	0	3	0	0	0	9	.8	21,201	.02
Seekonk	0	0	0	0	0	0	0	0	0	0	0	0	0	—	6,438	—
Somerset	0	0	0	0	0	0	0	0	2	0	0	0	2	.2	1,497	.08
Swansea	0	0	0	0	0	1	1	5	1	4	0	0	12	1.0	8,500	.07
Taunton	3	4	3	0	2	1	2	2	1	1	0	0	19	1.6	22,171	.05
Westport	0	1	4	13	9	8	6	1	12	2	2	5	63	5.3	21,229	.16
No Town Stated	11	5	0	0	0	0	6	3	1	0	3	2	31	2.6	—	—
Totals and Averages	68	95	69	98	96	117	99	82	83	42	83	31	963	80.3	236,375	.22

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY / Townships	Twelve Year's Legally-Reported Kill												Total	Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950				
DUKES																
Martha's Vineyard															Not Available.	
Tisbury	—	—	—	—	—	—	—	—	—	—	1	1	2	1.0	"	"
W. Tisbury	—	—	—	—	—	—	—	—	—	—	7	8	15	7.5	"	"
Oak Bluffs	—	—	—	—	—	—	—	—	—	—	0	0	0	—	"	"
Edgartown	—	—	—	—	—	—	—	—	—	—	0	0	0	—	"	"
Chilmark	—	—	—	—	—	—	—	—	—	—	26	16	42	21.0	"	"
Gay Head	—	—	—	—	—	—	—	—	—	—	14	10	24	12.0	"	"
Gosnold Group																
Naushon	—	—	—	—	—	—	—	—	—	—	14	58	72	36.0	3,000*	8.33
Pasque	—	—	—	—	—	—	—	—	—	—	16	12	28	14.0	—	—
Nashawena	—	—	—	—	—	—	—	—	—	—	0	1	1	.5	—	—
Cuttyhunk	—	—	—	—	—	—	—	—	—	—	0	0	0	—	—	—
No Town Stated	—	—	—	—	—	—	—	—	—	—	17	21	38	19.0	—	—
Totals and Averages	—	—	—	—	—	—	—	—	—	—	95	127	222	111.0	—	—

*Approximate figure.

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY Townships	Twelve Year's Legally-Reported Kill													Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total			
Essex																
Amesbury	0	0	0	0	0	2	1	0	2	0	4	1	10	.8	4,802	.11
Andover	0	0	0	1	0	0	2	1	0	0	0	3	7	.6	11,189	.03
Beverly	0	0	4	1	0	0	0	0	0	0	0	0	5	.4	6,469	.04
Boxford	0	0	0	0	0	0	11	1	5	3	4	1	25	2.1	11,176	.12
Danvers	0	0	0	0	0	0	0	0	1	1	1	0	3	.3	2,117	.09
Essex	0	0	2	0	2	2	7	3	6	2	1	8	33	2.8	3,904	.46
Georgetown	2	0	0	3	1	1	2	5	2	0	0	1	17	1.4	6,197	.14
Gloucester	0	2	0	0	1	0	1	0	0	4	3	4	15	1.3	12,590	.06
Groveland	0	0	0	0	0	0	0	0	0	0	2	0	2	.2	3,376	.04
Hamilton	0	0	0	0	2	1	3	3	5	4	5	3	26	2.2	3,601	.39
Haverhill	0	1	0	0	0	0	2	1	3	0	2	3	12	1.0	9,261	.07
Ipswich	5	7	8	5	2	17	4	10	31	17	26	22	154	12.8	7,167	1.15
Lawrence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	928	—
Lynn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,452	—
Lynnfield	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,950	—
Manchester	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,719	—
Marblehead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	706	—
Merrimac	0	0	0	0	0	1	1	0	1	0	2	1	6	.5	3,737	.09
Methuen	0	0	0	0	2	0	0	0	0	1	1	1	5	.4	9,620	.02
Middleton	0	1	1	1	0	0	0	0	3	0	0	1	7	.6	5,019	.07
Nahant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	—
Newbury	0	5	2	4	2	2	0	3	5	0	6	3	32	2.7	2,899	.60
Newburyport	0	0	0	1	0	0	0	0	0	0	0	0	1	.1	2,494	.03
No. Andover	0	0	0	0	0	1	0	2	0	0	0	0	3	.3	13,025	.01
Peabody	0	0	0	0	0	1	1	1	1	0	0	1	5	2.1	6,169	.22
Rockport	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,614	—
Rowley	7	14	3	0	0	0	0	2	10	2	10	6	54	4.5	7,551	.38
Salem	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,918	—
Salisbury	0	1	0	0	1	0	1	1	0	0	1	0	5	2.1	4,229	.32
Saugus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,158	—
Swampscott	0	0	0	0	0	0	0	0	0	0	0	0	0	0	235	—
Topsfield	0	2	1	3	0	1	4	4	10	13	10	9	57	4.8	4,151	.74
Wenham	0	0	0	0	0	0	0	0	3	1	2	1	7	.6	1,624	.24
West Newbury	0	0	1	0	1	1	6	0	0	1	5	0	15	1.3	1,624	.51
No Town Stated	1	0	0	0	0	0	1	0	2	1	1	1	7	.6	—	—
Totals and Averages	15	33	22	19	14	30	47	37	90	50	86	70	513	42.8	163,741	.17

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY Townships	Twelve Year's Legally-Reported Kill												Total	Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950				
Franklin																
Ashfield	6	13	11	19	10	16	21	15	23	16	47	24	221	18.4	14,534	.81
Bernardston	43	67	29	37	32	47	49	27	43	19	26	26	445	37.1	9,086	2.63
Buckland	9	15	5	17	20	16	18	6	1	7	14	20	148	12.3	8,951	.88
Charlemont	13	38	16	47	20	37	33	27	38	14	52	15	350	29.2	12,505	1.49
Colrain	23	32	23	42	63	53	50	16	46	27	72	39	486	40.5	15,587	1.66
Conway	13	31	14	40	12	26	26	9	36	26	38	29	300	25.0	7,557	2.13
Deerfield	4	0	9	16	23	17	39	14	12	7	24	9	174	14.5	12,209	.76
Erving	6	18	8	5	10	6	12	4	23	4	41	22	159	13.3	7,929	1.08
Gill	1	13	3	5	10	23	29	13	13	4	7	6	127	10.6	3,537	1.92
Greenfield	1	0	2	5	2	8	4	8	9	1	8	2	50	4.2	5,871	.46
Hawley	17	19	11	26	28	29	30	25	33	23	38	36	315	26.3	17,863	.94
Heath	20	30	26	32	21	28	19	34	17	18	19	14	278	23.2	11,768	1.27
Leverett	7	35	12	25	34	26	29	25	35	9	16	7	260	21.7	11,451	1.20
Leyden	13	16	11	27	10	8	16	3	9	5	13	9	140	11.7	6,660	1.12
Monroe	7	7	2	6	1	3	4	5	9	2	12	9	67	5.6	6,151	.58
Montague	13	25	3	11	19	13	20	14	26	17	27	18	206	17.2	15,213	.72
New Salem	10	41	19	29	81	94	124	61	100	34	88	54	735	61.3	27,211	1.44
Northfield	30	32	20	28	37	26	41	25	58	30	32	29	388	32.3	14,985	1.37
Orange	19	12	11	4	20	14	26	22	44	18	27	13	230	19.2	16,576	.74
Rowe	28	25	23	28	19	31	28	29	34	28	41	35	349	29.1	12,716	1.47
Shelburne	5	11	7	8	16	15	17	16	18	9	24	9	155	12.9	8,572	.96
Shutesbury	10	33	15	23	22	57	90	64	57	28	50	30	479	39.9	16,035	1.59
Sunderland	2	17	4	3	6	7	3	3	5	3	3	0	56	4.7	5,730	.52
Warwick	43	85	18	41	32	23	42	44	51	38	51	42	510	42.5	21,905	1.23
Wendell	26	49	19	23	37	37	74	44	54	25	50	43	481	40.1	18,316	1.41
Whatley	3	20	6	12	4	3	19	7	24	7	14	13	132	11.0	5,492	1.28
No Town Stated	36	12	2	2	6	2	10	3	2	6	8	14	103	8.6	—	—
Totals and Averages	408	696	329	561	595	665	873	563	820	425	842	567	7,344	612.0	314,410	1.25
Hampden																
Agawam	0	0	0	2	1	3	0	0	2	0	1	0	9	.8	7,132	.07
Blandford	36	43	38	44	19	43	37	30	49	46	59	62	506	42.2	31,161	.87
Brimfield	29	37	16	12	11	5	24	14	51	21	33	18	271	22.6	15,443	.93
Chester	13	32	14	38	24	58	40	22	37	22	50	33	383	31.9	21,818	.93
Chicopee	0	0	0	0	0	0	0	0	3	0	0	0	3	.3	8,797	.02
East Longmeadow	0	4	1	0	0	0	0	0	0	1	0	1	7	.6	3,903	.10
Granville	39	50	21	40	12	46	38	20	26	26	56	23	397	33.1	22,759	.93
Hampden	7	15	1	8	6	6	1	2	6	3	4	4	63	5.3	7,437	.45
Holland	13	37	26	32	22	11	19	13	18	11	10	9	221	18.4	6,359	1.85

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY / Townships	Twelve Year's Legally-Reported Kill															
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total	Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
Hampden (cont.)																
Holyoke	0	0	0	0	0	1	0	0	0	0	0	1	2	.2	8,868	.01
Longmeadow	0	0	0	0	0	1	0	0	0	0	0	0	1	.1	3,341	.02
Ludlow	1	8	0	8	4	7	6	3	10	1	14	3	65	5.4	9,706	.35
Monson	11	17	8	8	20	24	32	11	33	18	37	20	239	19.9	20,607	.62
Montgomery	0	2	0	3	2	3	11	4	7	2	11	1	46	3.8	8,869	.27
Palmer	11	15	12	8	5	6	16	6	13	5	9	2	108	9.0	15,493	.37
Russell	2	14	4	7	1	5	12	3	8	9	19	11	95	7.9	10,399	.48
Southwick	0	0	0	0	0	0	0	1	0	0	0	0	1	.1	13,485	.01
Springfield	0	0	0	0	0	0	0	0	1	0	0	0	1	.1	9,830	.01
Tolland	40	33	17	27	18	34	15	11	25	15	30	22	287	23.9	19,428	.79
Wales	22	26	23	26	19	13	16	18	16	10	22	5	216	18.0	8,366	1.37
West Springfield	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,703	—
Westfield	3	4	4	3	1	7	1	0	5	1	4	1	34	2.8	15,493	.12
Wilbraham	7	6	0	4	1	0	1	1	0	1	4	1	26	2.2	9,314	.15
No Town Stated	33	7	3	0	0	0	1	2	10	0	6	9	71	5.9	—	—
Totals and Averages	267	350	188	270	166	273	270	161	320	192	369	226	3,052	254.3	284,711	.57
Hampshire																
Amherst	4	5	1	1	5	5	4	6	15	3	4	3	56	4.7	6,844	.43
Belchertown	4	13	20	33	41	45	49	49	67	37	47	46	451	37.6	22,938	1.05
Chesterfield	12	10	15	19	15	30	18	19	32	24	51	16	261	21.8	17,243	.81
Cummington	5	5	8	21	9	21	17	15	22	16	32	12	183	15.3	12,104	.81
Easthampton	0	3	1	2	0	0	0	0	1	0	1	0	8	.7	2,761	.16
Goshen	2	3	4	12	4	23	6	5	9	4	21	15	108	9.0	9,459	.61
Granby	0	5	0	0	2	5	2	6	7	2	8	0	37	3.1	10,474	.19
Hadley	1	3	0	0	0	0	0	1	3	2	1	0	11	.9	6,817	.09
Hatfield	0	7	5	6	10	18	8	4	5	7	7	1	78	6.5	5,532	.75
Huntington	2	11	4	9	6	31	20	6	13	11	18	15	146	12.2	13,963	.56
Middlefield	0	35	14	28	14	31	19	11	29	15	31	10	237	19.8	11,994	1.06
Northampton	1	0	0	0	0	3	0	2	0	0	1	1	8	.7	14,739	.03
Pelham	3	29	5	22	14	29	84	47	55	36	37	50	411	34.3	14,706	1.49
Plainfield	6	13	4	21	10	7	9	12	21	9	24	6	142	11.8	11,589	.65
So. Hadley	0	0	0	0	0	1	1	0	1	0	2	1	6	.5	6,810	.04
Southampton	0	1	1	0	0	2	0	0	1	1	3	3	12	.1	12,021	.01
Ware	4	13	24	22	31	41	78	43	40	23	31	31	381	31.8	11,639	1.75
Westhampton	7	20	5	17	6	6	15	1	12	2	15	3	109	9.1	15,998	.36
Williamsburg	3	14	2	10	7	7	16	8	22	11	32	11	143	11.9	13,105	.58
Worthington	12	18	13	18	13	20	11	8	33	7	47	26	226	18.8	17,079	.70
No Town Stated	8	1	2	1	1	1	9	6	7	1	9	11	57	4.8	—	—
Totals and Averages	74	209	128	242	188	326	366	249	395	211	422	261	3,071	255.9	237,815	.69

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY / Townships	Twelve Year's Legally-Reported Kill													Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total			
Middlesex																
Acton	0	3	0	0	0	2	2	0	1	0	0	1	9	.8	6,803	.07
Arlington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	739	—
Ashby	1	6	1	3	8	8	6	5	8	7	11	10	74	6.2	10,719	.37
Ashland	0	0	2	0	0	1	0	4	0	0	2	1	10	.8	6,404	.08
Ayer	2	1	0	0	2	0	5	2	3	3	5	0	23	1.9	3,727	.33
Bedford	0	0	0	0	0	0	0	0	1	0	0	1	2	.2	5,221	.02
Belmont	0	0	0	0	0	0	0	0	0	0	0	0	0	0	281	—
Billerica	0	0	0	0	0	0	0	1	0	0	0	0	1	.1	11,580	.01
Boxborough	0	0	0	0	0	0	2	1	1	1	1	0	6	.5	4,121	.07
Burlington	0	0	0	0	0	0	0	0	0	0	0	1	1	.1	4,900	.01
Cambridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	697	—
Carlisle	0	0	0	0	0	0	1	1	1	2	0	0	5	.4	7,581	.03
Chelmsford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	383	—
Concord	1	1	0	0	0	0	3	0	2	1	1	1	10	.8	8,813	.05
Dracut	0	1	0	0	2	2	3	1	1	0	3	2	15	1.3	6,340	.13
Dunstable	0	3	0	0	3	8	9	3	14	13	20	14	87	7.3	6,739	.69
Everett	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83	—
Framingham	0	0	0	0	0	0	4	0	2	0	9	0	15	1.3	6,793	.12
Groton	5	13	11	12	6	12	41	19	24	15	51	16	225	18.8	13,462	.89
Holliston	0	0	0	0	0	0	0	0	0	1	0	0	1	.1	7,891	.01
Hopkinton	0	0	1	1	1	0	3	4	1	1	4	1	17	1.4	11,689	.08
Hudson	0	0	0	0	1	0	0	0	0	0	1	0	2	.2	5,060	.03
Lexington	0	0	0	0	0	0	2	0	0	0	0	0	2	.2	5,505	.02
Lincoln	0	0	0	0	0	1	6	1	2	0	0	0	10	.8	5,862	.09
Littleton	1	1	0	0	0	1	5	7	12	5	8	3	43	3.6	3,518	.65
Lowell	0	0	0	0	0	0	0	0	0	0	0	0	0	0	146	—
Malden	0	0	0	0	0	0	0	0	0	0	0	0	0	0	661	—
Marlborough	0	7	0	0	0	0	2	1	4	1	1	3	19	1.6	8,519	.12
Maynard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,945	—
Medford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,858	—
Melrose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	629	—
Natick	0	0	0	0	1	0	0	0	1	0	0	0	2	.2	5,295	.02
Newton	1	0	0	0	0	0	0	0	1	0	0	0	2	.2	2,487	.05
North Reading	0	0	0	0	0	0	2	1	0	0	0	0	3	.3	4,857	.04
Pepperell	1	10	1	2	0	0	16	6	18	12	19	13	98	8.2	10,710	.49
Reading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,704	—
Sherborn	0	0	0	0	0	0	0	2	0	0	0	2	4	.3	7,767	.02
Shirley	6	17	1	3	1	3	5	9	9	4	15	8	81	6.8	6,206	.70
Somerville	0	0	0	0	0	0	0	0	0	0	0	0	0	0	174	—
Stoneham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,720	—
Stow	0	0	0	0	0	0	0	0	1	0	1	0	2	.2	6,139	.02

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY / Townships	Twelve Year's Legally-Reported Kill													Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total			
Middlesex (cont.)																
Sudbury	0	1	0	0	0	6	2	0	1	2	6	3	21	1.8	6,674	.17
Tewksbury	0	0	0	0	0	0	0	1	5	0	0	1	7	.6	7,048	.06
Townsend	9	7	7	1	2	4	16	12	9	10	39	22	138	11.5	16,140	.45
Tyngsboro	0	1	0	1	0	1	5	0	7	1	6	1	23	1.9	7,429	.16
Wakefield	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,081	—
Waltham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,261	—
Watertown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	318	—
Wayland	0	2	0	0	0	0	0	0	0	0	1	0	3	.3	5,896	.03
Westford	0	2	0	0	0	1	4	3	5	4	7	2	28	2.3	11,939	.12
Weston	0	0	0	0	0	0	0	1	0	0	0	0	1	.1	9,660	.01
Wilmington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,238	—
Winchester	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,224	—
Woburn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,144	—
No Town Stated	2	0	0	0	0	0	0	0	0	0	0	1	3	.3	—	—
Totals and Averages	29	76	24	23	27	50	144	85	134	83	211	107	993	82.8	291,780	.18
Nantucket																
Nantucket	82	48	44	35	34	49	30	41	66	47	85	53	614	51.2	16,160	2.04
Norfolk																
Avon	CLOSED SEASON							0	0	0	0	0	0	0	2,318	—
Bellingham	"							1	1	1	5	0	8	1.6	9,288	.11
Braintree	"							0	0	0	0	0	0	0	5,894	—
Brookline	"							0	0	0	0	0	0	0	1,249	—
Canton	"							0	0	0	0	0	0	0	8,976	—
Cohasset	"							0	0	0	0	0	0	0	4,345	—
Dedham	"							0	0	0	0	0	0	0	3,909	—
Dover	"							0	0	0	2	0	2	.4	7,097	.04
Foxborough	"							3	6	0	0	0	9	1.8	9,972	.11
Franklin	"							0	2	2	0	2	6	1.2	11,344	.07
Holbrook	"							0	0	0	0	0	0	0	3,459	—
Medfield	"							1	3	1	7	1	13	2.6	6,435	.25
Medway	"							0	0	0	0	0	0	0	3,811	—
Millis	"							1	0	2	3	1	7	1.4	4,659	.19
Milton	"							0	0	0	0	0	0	0	5,680	—
Needham	"							0	0	0	1	0	1	.2	4,361	.03
Norfolk	"							1	2	2	0	0	5	1.0	6,937	.09
Norwood	"							0	0	0	0	1	1	.2	2,782	.05
Plainville	"							0	4	1	5	0	10	2.0	5,303	.24
Quincy	"							0	0	0	0	0	0	0	3,354	—

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY Townships	Twelve Year's Legally-Reported Kill 1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total	Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
NORFOLK (cont.)	CLOSED SEASON (Cont.)															
Randolph			"		"			0	0	0	0	0	0	0	4,746	—
Sharon			"		"			0	1	0	3	1	5	1.0	13,078	.05
Stoughton			"		"			0	0	0	0	0	0	0	7,862	—
Walpole			"		"			0	1	0	0	0	1	2.0	9,026	.14
Wellesley			"		"			0	0	0	0	0	0	0	4,551	—
Westwood			"		"			0	1	0	0	0	1	2.0	4,156	.31
Weymouth			"		"			0	0	0	0	0	0	0	5,936	—
Wrentham			"		"			3	5	0	4	2	14	2.8	10,381	.17
No Town Stated								0	1	0	0	0	1	2.0	—	—
Totals and Averages								10	27	9	30	8	84	16.8	170,909	.06
PLYMOUTH																
Abington	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,840	—
Bridgewater	1	5	2	4	1	0	1	1	7	0	1	4	27	2.3	9,517	.15
Brockton	2	3	1	0	0	0	0	0	0	0	0	0	6	.5	8,315	.05
Carver	5	1	14	11	7	6	10	9	8	6	8	7	92	7.7	12,087	.41
Duxbury	0	7	3	0	0	0	1	4	2	4	0	7	28	2.3	12,425	.12
East Bridgewater	0	0	0	0	0	0	6	0	1	0	4	1	12	.1	7,489	.01
Halifax	0	0	2	0	2	0	3	3	4	3	3	5	25	2.1	7,671	.18
Hanover	0	0	0	0	0	0	0	0	1	0	0	2	3	.3	6,794	.03
Hanson	0	1	0	0	0	0	0	0	0	0	0	0	1	.1	6,327	.01
Hingham	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,667	—
Hull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	—
Kingston	0	0	0	0	1	0	3	2	4	0	1	4	15	1.3	9,904	.08
Lakeville	4	18	2	5	9	19	14	20	12	9	16	9	137	11.4	13,463	.54
Marion	0	0	0	0	0	0	0	0	2	1	0	1	4	.3	6,371	.03
Marshfield	5	6	6	1	0	2	0	8	1	2	15	10	56	4.7	10,150	.30
Mattapoisett	0	0	2	1	2	2	3	4	5	3	4	5	31	2.6	8,239	.20
Middleborough	7	22	16	15	14	18	24	19	34	17	19	7	212	17.7	32,101	.35
Norwell	0	0	0	0	0	0	0	1	0	1	3	0	5	.4	9,491	.03
Pembroke	3	7	5	1	1	0	5	5	6	0	1	5	39	3.3	10,980	.19
Plymouth	35	53	48	52	45	74	46	59	61	26	33	23	555	46.3	54,143	.55
Plympton	0	0	0	2	0	1	2	3	7	2	1	6	24	2.0	7,226	.18
Rochester	1	6	0	4	6	0	2	8	8	7	1	7	50	4.2	18,168	.14
Rockland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,262	—
Scituate	0	0	0	0	0	0	0	0	0	0	0	1	1	.1	6,067	.01
Wareham	4	1	6	6	8	3	3	2	9	3	2	2	49	4.1	17,352	.15
West Bridgewater	1	0	1	0	0	2	0	0	0	0	0	0	4	.3	3,702	.05
Whitman	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,705	—
No Town Stated	25	1	0	0	8	6	9	4	6	2	3	6	70	5.8	—	—
Totals and Averages	93	131	108	102	104	133	132	152	178	86	115	112	1,446	120.5	296,469	.26

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY Townships	Twelve Year's Legally-Reported Kill													Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	Total			
Worcester																
Ashburnham	0	8	4	8	5	14	11	9	36	20	35	15	165	13.8	19,050	.46
Athol	22	30	18	19	18	16	25	25	26	9	29	24	261	21.8	16,802	.83
Auburn	0	0	0	0	0	0	0	1	0	2	0	0	3	.3	6,900	.03
Barre	10	13	10	17	28	17	49	26	58	20	33	24	305	25.4	19,978	.81
Berlin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,505	—
Bolton	0	2	0	1	0	0	3	4	0	0	1	3	14	1.2	9,355	.08
Blackstone	0	0	0	1	0	0	0	0	1	1	8	0	11	.9	4,538	.13
Boylston	1	1	0	0	1	1	0	0	2	2	0	0	8	.7	8,458	.05
Brookfield	3	12	0	4	1	2	6	1	13	1	7	3	53	4.4	4,409	.64
Charlton	3	3	1	5	1	0	5	1	2	2	16	2	41	3.4	15,005	.15
Clinton	1	1	0	0	0	0	0	0	0	0	0	0	2	.2	2,128	.06
Douglas	4	8	1	1	0	0	3	0	1	0	4	0	22	1.8	19,939	.06
Dudley	1	0	1	0	0	0	3	0	0	0	0	1	6	.5	6,000	.05
East Brookfield	0	0	0	0	1	6	6	0	4	0	9	2	28	2.3	3,703	.40
Fitchburg	0	1	1	0	0	1	0	1	1	0	0	0	5	.4	9,560	.03
Gardner	0	1	0	0	5	2	1	1	3	0	3	0	16	1.3	9,780	.09
Grafton	0	2	0	0	0	1	0	0	0	3	1	1	8	.7	8,233	.05
Hardwick	8	29	16	35	48	50	79	79	84	34	82	69	613	51.1	18,630	1.75
Harvard	4	12	2	5	3	9	20	4	11	4	2	2	78	6.5	12,809	.32
Holden	1	0	0	1	1	0	0	1	1	0	1	1	7	.6	19,313	.02
Hopedale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,322	—
Hubbardston	5	4	1	1	5	2	15	13	9	6	24	6	91	7.6	21,070	.23
Lancaster	3	4	7	4	1	6	9	13	9	0	11	1	70	5.8	13,125	.28
Leicester	0	0	0	0	0	1	1	2	0	0	2	0	6	.5	10,655	.03
Leominster	1	1	1	0	0	3	2	2	2	2	3	1	18	1.5	11,234	.09
Lunenburg	4	4	0	0	0	1	2	1	3	3	3	1	22	1.8	10,671	.11
Mendon	1	1	0	0	0	0	6	0	2	1	2	1	14	1.2	8,170	.09
Milford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,988	—
Millbury	0	0	0	0	0	1	1	0	0	0	0	0	2	.2	6,983	.02
Millville	0	0	0	0	0	0	0	0	1	0	0	0	1	.1	2,250	.03
New Braintree	0	1	3	1	0	1	4	1	1	1	2	0	15	1.3	7,208	.12
North Brookfield	0	2	0	0	4	2	3	1	0	0	0	1	13	1.1	7,599	.09
Northborough	0	2	0	0	0	0	1	0	0	1	3	0	7	.6	7,287	.05
Northbridge	1	0	0	0	0	0	0	0	1	0	2	0	4	.3	8,058	.02
Oakham	1	8	2	4	6	3	3	3	9	3	7	1	50	4.2	11,051	.24
Oxford	1	0	0	0	1	0	0	0	0	0	0	0	2	.2	9,306	.01
Paxton	0	0	0	0	1	1	0	1	2	1	2	1	9	.8	7,502	.07
Petersham	24	64	38	79	135	155	245	153	211	50	108	114	1,376	114.7	32,791	2.22
Phillipston	13	24	9	8	12	7	15	12	14	7	12	9	142	11.8	12,967	.58
Princeton	7	25	6	4	20	17	15	9	19	12	28	8	170	14.2	16,916	.54
Royalston	42	105	33	56	73	61	62	56	73	32	73	22	688	57.3	24,892	1.47

Massachusetts Deer Kill by Townships and Counties (Continued)

1939 - 1950

COUNTY Townships	Twelve Year's Legally-Reported Kill												Total	Yearly Ave.	Acres of Deer Range	No. of Deer Killed Per Sq. Mi. of Deer Range
	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950				
Worcester (cont.)																
Rutland	4	3	3	3	6	5	16	10	15	4	33	23	125	10.4	16,768	.40
Shrewsbury	0	1	1	0	0	1	1	0	3	1	1	0	9	.8	7,848	.07
Southborough	0	0	1	3	1	2	6	4	7	6	6	4	40	3.3	3,689	.57
Southbridge	11	9	11	18	3	14	10	8	19	9	11	8	131	10.9	8,357	.82
Spencer	1	3	1	0	1	2	3	1	3	0	5	4	24	2.0	12,878	.09
Sterling	1	6	2	2	4	5	14	9	11	4	19	5	82	6.8	10,873	.40
Sturbridge	19	16	29	17	12	17	28	15	20	15	22	20	230	19.2	17,944	.68
Sutton	1	0	0	0	0	0	1	0	1	0	2	3	8	.7	13,246	.03
Templeton	3	4	4	2	2	2	7	6	12	7	14	12	75	6.3	15,717	.26
Upton	1	2	0	0	0	0	1	0	1	0	7	0	12	.1	10,271	.01
Uxbridge	0	0	1	0	0	4	6	1	1	0	4	1	18	1.5	14,716	.07
Warren	11	18	4	3	2	8	10	11	14	6	21	7	115	9.6	5,808	1.05
Webster	2	0	1	0	0	0	0	0	0	0	0	0	3	.3	5,207	.04
West Boylston	0	1	0	0	0	0	0	0	5	1	3	0	10	.8	4,530	.11
West Brookfield	0	9	7	6	0	4	11	2	6	2	6	2	55	4.6	8,563	.34
Westborough	0	1	0	1	0	0	3	5	5	2	2	3	22	1.8	6,182	.18
Westminster	1	8	0	3	3	1	1	4	5	7	21	3	57	4.8	17,033	.18
Winchendon	8	4	8	3	5	5	18	15	30	17	38	12	163	13.6	24,517	.35
Worcester	0	0	0	0	0	1	0	0	0	0	0	1	2	.2	9,256	.01
No Town Stated	0	6	3	0	1	0	19	2	6	2	9	7	55	4.6	—	—
Totals and Averages	224	459	230	315	410	451	750	513	763	302	737	428	5,582	465.2	671,543	.44

MASSACHUSETTS DIVISION OF FISHERIES & GAME
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